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Copyright Information

About Software Copying

Thank you for purchasing SuperLab Pro, an experimental tool we hope will serve you well.

SuperLab Pro is the result of long, long hours of work. We've put a lot of time into it so you won't have to. And we'd like to continue improving it and implementing your ideas and suggestions.

So please, we *plead* with you, if you must show SuperLab Pro to a friend or colleague, do NOT give them the fully functional version; instead, give them a demonstration version or our contact information to send them a free demo. Giving away the fully functional version, in addition to being unethical and a punishable crime, results in fewer sales and discourages us from continuing to support and improve the product.

Thanks again for choosing SuperLab Pro. We wish you success in your work.

"I had cleaned my bedroom, and went all around the room. I came up to the couch, and could not remember whether I had dusted it or not. Since these motions were habitual and unconscious, I couldn't even perceive that it was now impossible to remember them. So if I had already cleaned the couch and forgot about it — that is, if I had acted unconsciously — it was as if I had never done it."

— Leo Tolstoy

Chapter 1 - Introduction

Welcome to SuperLab Pro.

SuperLab Pro is a fine tool for setting up and running experiments. With its various built-in editors, you can interactively set up an experiment that presents visual stimuli on a monitor, plays auditory stimuli over headphones or speakers, or interacts with laboratory equipment. Experiments are saved in a text-only file. SuperLab Pro can collect the data with one millisecond accuracy or better.

Other features in SuperLab Pro let you change the placement of visual stimuli on the screen, change the screen's background color, choose from a variety of input and timing options, and provide feedback to subjects based on either response or reaction time. And while building your experiment, you can do it all with a familiar point-and-click user interface.

If You Hate Reading Manuals...

...then please read at least this section.

Using SuperLab Pro, while easy, assumes you are familiar with a graphical user interface such as Microsoft Windows or the Macintosh, and some standard techniques such as selecting an item from the menu bar, opening and saving files, double-clicking, and so forth.

To run an experiment...

If all you will be doing is running experiments already written, using SuperLab Pro is straightforward. Just run the program, choose Open from the File menu to load the experiment file, then choose Run from the Experiment menu. That's it!

But to develop an experiment...

If you will be developing new experiments, you should be familiar with the terminology and concepts that SuperLab Pro introduces. It is strongly suggested you spend some time going through at least the rest of this chapter and the next one, "SuperLab Pro Basics." It takes no more than 20 or 25 minutes, and is well worth the time spent.

Beyond the "SuperLab Pro Basics" chapter, the rest of this manual is mainly for reference, complemented by the online help file.

To install SuperLab Pro on your computer:

1. Start Microsoft Windows.

2. Insert the SuperLab Pro distribution diskette into your floppy drive.

3. From the File menu in either the Program Manager or File Manager, choose Run.

4. Type a:\setup (or b:\setup).

5. Press Enter.

The install program will run. Follow the on-screen instructions, which prompt you for the optional components you'd like to install (e.g. SuperLab SDK) and the directory location.

The install program creates a file named "install.log" in your SuperLab directory. Keep this file; it is necessary if you want to uninstall SuperLab Pro at a later time.

What's Not in This Manual

Some things are not in this manual but can be found in the online help files that come with SuperLab Pro. Notably, the experiments' file format is available only in electronic form. In addition, the SuperLab Software Development Kit (SuperLab SDK) is entirely in electronic form. If you have written Windows software before, you will find that the SuperLab SDK documentation has a familiar feel to it.

And last but not least, it is much easier to update and distribute documentation in electronic form than in printed form. So if you think any information is missing from this manual, check the online help first. Try the following:

1. In SuperLab Pro, choose "Search for Help on" from the Help menu. A dialog will appear.

2. Type "information not" and a topic named "Information Not Found in the Manual" will be highlighted.

3. Press the Enter key twice and a list of information not found in the manual will appear.

If you still cannot find the information you need or feel that a topic of interest has not been adequately described, please take the time to send us email or call; we want to hear from you, otherwise the weaknesses in the documentation will never be improved.

Cedrus Support

Cedrus provides three communication channels for asking questions, reporting bugs, or simply telling us what is on your "wish list."

In general, if you have a question, please check this manual first; you may find the answer is already in it. In particular, check the table of contents in the beginning, the index at the end, and the "Frequently Asked Questions" section in the "More on SuperLab Pro" chapter. Also, check the online help file, accessible by choosing Contents from the Help menu in SuperLab Pro.

Additionally, you can also check our Web site. The SuperLab Pro support page has a list of frequently asked questions (FAQs) and we have plans to add application notes. The URL is **http://www.cedrus.com**.

By Electronic Mail This is the preferred method. It allows us to archive your questions and comments faster and easier, gives us more time to research your question, and it is available to you anytime of the day or the year. The Internet address is **superlab@cedrus.com**. Most questions via electronic mail are usually answered within 24 hours.

By Telephone The hours are 10 AM to 5 PM Mountain Standard Time (MST) time. The number is **1-800-CEDRUS1** (that's **1-800-233 7871**). It is available toll free anywhere in the United States and Canada. If you are calling from overseas or from the Phoenix, Arizona, metropolitan area, the number is **1-602-631 9044**.

When calling by phone, we can help you best if the telephone is next to the computer where SuperLab is installed.

By Fax The number is **1-602-631 9047**. Please provide both of your phone and fax numbers.

The WebAnnounce Service

WebAnnounce is an email notification service. When you subscribe, you will get occasional email messages about the latest SuperLab Pro news. The URL is **http://www.cedrus.com/superlab/webannounce.htm**. WebAnnounce is the best way to stay in touch with the latest developments at Cedrus.

Credits

Paying tribute is always a risky endeavor because someone will be unfairly forgotten. But it would be more unfair not to recognize the ones we do remember.

For the original product idea and continued guidance, thanks to Dr. James Haxby, Chief of the Section on Functional Brain Imaging, Laboratory of Psychology and Psychopathology, National Institute on Mental Health; and Dr. Raja Parasuraman, Director, Cognitive Science Laboratory, The Catholic University of America.

For the invaluable feedback and enthusiastic support, thanks to Dr. François Lalonde, Senior Scientist Officer, Laboratory of Psychology and Psycho-pathology, National Institute on Mental Health; and to Dr. Chris Chase, Hampshire College.

The list is much longer than that. It includes customers who provided great new ideas, beta testers who volunteered time and effort, and friends who were supportive all around. To all of you, thank you.

Chapter 2 - SuperLab Pro Basics

SuperLab Pro is a powerful yet easy to use tool for setting up and running experiments. It has several built-in editors that let you setup the experiment interactively.

In this tutorial chapter, you'll learn how to create an experiment. The sample experiment in this tutorial assumes a human subject, but concepts learned are applicable througout SuperLab Pro. We will use visual stimuli files provided on the SuperLab Pro distribution diskette. The experiment will be a smaller version of the Letter Rotation demonstration included on your diskette. Going through this chapter takes approximately 25 minutes.

To start, run SuperLab Pro. You do that by double-clicking on the program's icon in the Program Manager. When the program starts, a window similar to this next one opens.
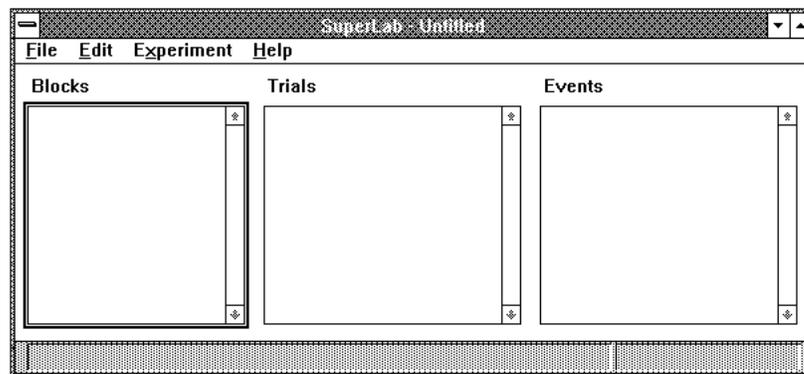
This is the main Experiment Editor where all trials are created. The smallest unit of an experiment is the event, usually a stimulus or a control signal. A trial is a set of events, and a block is a set of trials. To run an experiment, you must have at least one block, one trial, and one event.

Note that a selection rectangle is drawn around the list of blocks. To familiarize yourself with the SuperLab Pro workspace, try the following steps:

≡   Click on the Edit menu. A menu will appear.

- Choose the menu item One New Block. This will cause a small dialog to appear. It's the Block Editor.

- Type "Instructions".

- Click on the OK button. The Block Editor will go away, and "Instructions" will appear in the list of blocks.

- In the main Experiment Editor, click on the list of trials. The selection rectangle will move from the list of blocks to the list of trials.

- Click on the Edit menu again.

Note how some menu items have changed. The item that used to read "One New Block" now reads "One New Trial". This is because the Edit menu is a dynamic menu, meaning that its items change depending on your actions.

Release the mouse button to make the Edit menu go away. We will not create a trial at this time.

Before we start creating events and trials, we need to tell SuperLab Pro what responses are to be accepted from the subject. In the case of this Letter Rotation experiment, it will be the letter B for backward and the space bar for forward. To start, go to the Experiment menu and choose Responses. The Response Editor will appear:

- In the Response Editor window, click on the New button. A small dialog box appears.

- To define the space bar as a forward response, press the space bar once. Click on the OK button.

- Click on the New button again. To define "B" as a backward response, type the letter B. Everything you type is converted to uppercase; SuperLab Pro ignores the character case. Click on the OK button.
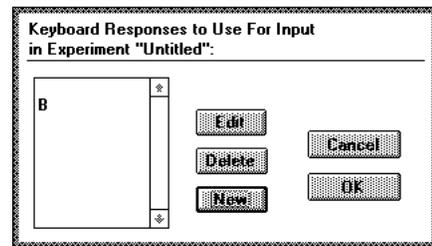
We're done. The space bar and the B character are now defined as responses for the experiment. You can define up to 64 responses this way, each having from 1 to 11 characters.

Before proceeding any further, let us save what we have done so far. We may not have accomplished much yet, but it is always a good idea to save, and save frequently. Choose Save from the File menu. You'll get a dialog similar to the following:

File **N**ame:
firstone

Directories:
d:\superlab

d:\
superlab
help

OK

Cancel

Save File as **T**ype:
SuperLab Experiment (*.

Dri**v**es:
d: apps, etc..
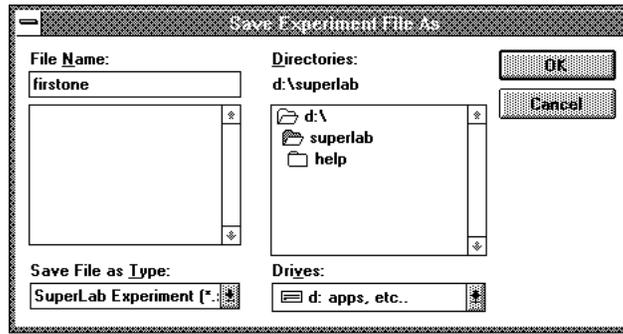
In the edit box at the top, type the name you would like to give to the experiment, say "firstone.xpt" We suggest you always give your file names the .XPT extension. For convenience, SuperLab Pro will insert the .XPT extension automatically if you do not type it, so you can just type "firstone" and the file will be saved as "firstone.xpt". When you are ready, click on the OK button and SuperLab Pro will save the experiment to disk.

There is a fact worth noting here. SuperLab Pro saves its experiments in readable text files. This means that you do not have to use only SuperLab Pro's editors; since the file format is fully described in the online help file, you can use any text editor, word processor, or spreadsheet program to edit an experiment. And, if you are handy with programming, you can even write BASIC, Pascal, or C language programs to generate experiments automatically.

Creating the Events

Back to the experiment; you are now ready to create your first event. In the Experiment Editor window, click on the list of events to move the selection rectangle to it, then choose One New Event from the Edit menu. The Event Editor appears. Do not type anything yet.

An event is the smallest unit of an experiment. It is where you tell SuperLab Pro what to present to the subject, what response to accept, and how to provide feedback based on that response. To keep things simple without sacrificing features, the Event Editor is divided into three "property sheets" (also called sections) named Input, Feedback, and Event. You switch between the three property sheets by clicking on the corresponding button.

Click on the Event button to switch to that property sheet. This is where you control what to present to the subject, and how. Click on the Event Type combo box; it shows five types of events. Try choosing different types; when you do, notice how the contents of the Event Editor change automatically depending on your choice. These items are, in alphabetical order:

❏   Sound File. Allows you to use a .WAV file to play auditory stimuli.

❏   Digital Output. Using this optional feature, you can send pulses or control
     digital i/o lines using third party cards such as the Computer Boards' CIO-
     DIO24 or National Instruments LabPC card. This feature is very useful if
     you want to interact with or control equipment outside your PC, e.g.
     control laboratory apparatus, turn lamps on or off, trigger an MRI machine,
     or synchronize two or more different computers.

❏   Inter-Stimulus Interval (ISI). Introduces a waiting period.

❏   Picture File. Allows you to use any .BMP file to draw visual stimuli.

❏   Text. Lets you present simple text stimuli without requiring a bitmap file,
     with full control over font, size, and other attributes.
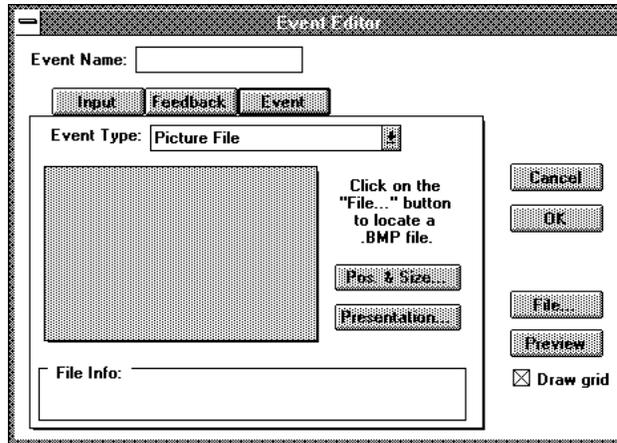
For this first event, we would like to greet the subject with some instructions.
Make sure that the event type selected is Picture File. Click on the File button. A
familiar "open file" dialog appears:
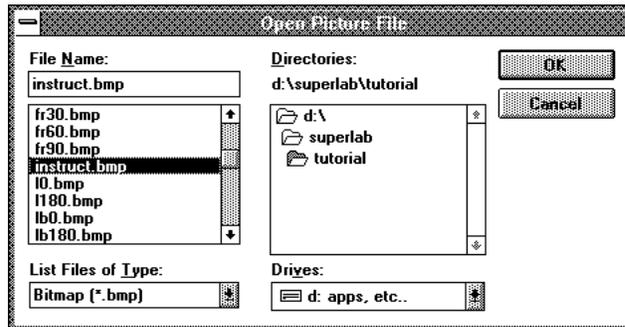
The file we want to open is called "instruct.bmp" and is located in the "tutorial"
directory. Once you have located the "instruct.bmp" file, click on it to select it

then click on the OK button.

Now, you are back in the Event Editor dialog. This is how it should look:

The gray rectangle has been replaced by a "mini" view of the picture. In the File Info area, some information is now displayed about the file you have just opened.

To save you time, SuperLab Pro has also inserted an event name automatically; it stripped the file extension and converted the first letter to upper case. Complete the event name to read "Instructions." If you already had an event name typed, SuperLab Pro would not have replaced it. Speaking of event names, they must be unique. Even though a trial and an event can have the same name, no two events may share the same name. The same rule applies to trial and block names: no two trials and no two blocks may have the same name.

To see the picture exactly as it will be presented to the subject:

≡ Click on the Preview button.

≡ By default, the picture is centered both horizontally and vertically, and is drawn at the same size it was created with. Both the position and size can be edited, but in this experiment we will use SuperLab Pro's default values.

≡ When previewing, SuperLab Pro displays in the bottom left corner of the screen the time it took to display the picture.

≡ When done looking at the picture, click the mouse button or press any key.

You should now be back in the Event Editor dialog. Click on the OK button.

Events

◇ Instructions

In the Experiment Editor, you will find the event we just created, "Instructions," listed under "Events" (see picture on the left). Note that it is preceded by a hollow diamond (◇). More on that in a little bit.

Our tutorial experiment is to contain four visual stimuli in addition to the instructions screen in the beginning. To proceed, make sure the selection rectangle is around the list of events then click on the Edit menu and choose Many New Events. This feature works similarly to One New Event except that the Event Editor remains on the screen until you click on the Cancel button. This saves time over having to choose One New Event from the Edit menu every time.

The four picture files to be used as visual stimuli are "f0.bmp," "lr30.bmp," "f180.bmp," and "rbl60.bmp." Even though these file names may seem cryptic, they are not random. The first letter indicates the character to be presented to the subject (F, L, or R) and the digits indicate the rotation angle of the letter. The letter B, when present, indicates that the character to be presented is backward. When creating your own experiments with SuperLab Pro, we suggest you use a similarly consistent file naming convention.

Once in the Event Editor dialog, proceed as follows. For file "f0.bmp":

1   Click on the File button. The familiar "open file" dialog opens.

2   Locate the file "f0.bmp" and click on OK. The "open file" dialog goes away.

3   Click on the OK button again. The Event Editor will remain on the screen, but will now be ready for creating another event.
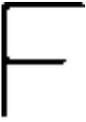
Stimulus F0

To create the next event for file "lr30.bmp":

1   Click on the File button to open the "open file" dialog.

2   Locate the file "lr30.bmp" and click on OK. The "open file" dialog goes away.

3   Click on the OK button again. The Event Editor will remain on the screen.

Stimulus LR30

The next event is "f180.bmp":

1   Click on the File button to open the "open file" dialog.

2   Locate the file "f180.bmp" and click on OK.

3   Click on the OK button again.
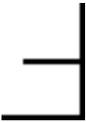
Stimulus F180

The next event is "rbl60.bmp":

1   Click on the File button to open the "open file" dialog.

2   Locate the file "rbl60.bmp" and click on OK.

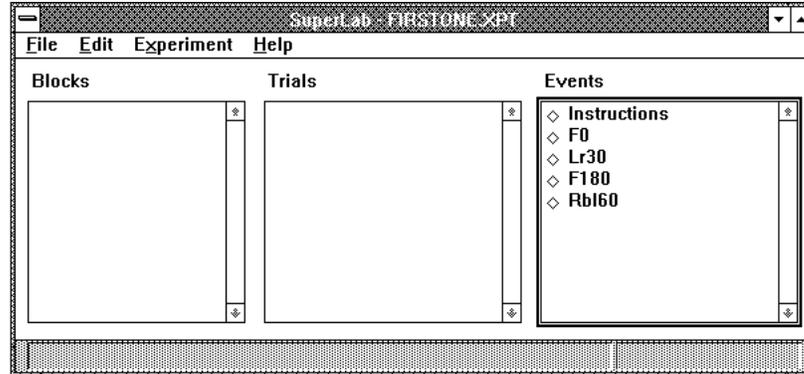3   Click on the OK button again. The Event Editor will remain on the screen.

You have finished creating the four events. Click on the Cancel button; the Event Editor will now go away. This is how the Experiment Editor now looks:

Choose Save from the File menu to save your work so far.

Controlling Input   The original letter rotation experiment was designed and built using SuperLab Pro at the National Institute on Aging in Bethesda, Maryland. As designed, every letter is supposed to stay on the screen until the subject responds correctly. With the events created so far, you haven't setup yet how they interact with the subject, so you need to that next. In the process, you will learn about two new ways to use the Event Editor, the same one you used to create the events.

1   In the list of events in the Experiment Editor, click on event F0 to select it.

2   Hold down the Shift key on your keyboard and click on event Lr30. Holding down the Shift key allows you to make multiple selections.

3   While still holding down the Shift key, click on events F180 and Rbl60 to select them too. Release the Shift key and mouse button. You should now have four events selected at the same time.

4   Choose Edit Event from Edit menu.

The Event Editor will appear again, but with one important difference: this time you are not creating a new event, you are editing four events *at the same time.* Any change you make here will affect all the events currently selected. This is a powerful editing feature, one that you will come to rely on as you become more experienced with SuperLab Pro.

1   In the Event Editor, click on the Input button to switch to the Input property sheet.

2   Click on the "Correct key" radio button to select it.

3   Click on OK. The Event Editor will go away, and all four events are now setup so that the subject has to answer correctly.

So far so good. But there is one thing left to be done: even though you setup all four events to end only with the correct response, you still have not told SuperLab Pro what is in fact the correct response.

1   In the list of events in the Experiment Editor, click on event F0. This will select it and deselect all the others.

2   Choose Edit Event from Edit menu.

3. Click on the "Correct response" combo box; a list will appear with three items in it: (none), blank, and B. The first one, (none), means that no response is currently defined as being the correct one. The next two are the responses you've defined using the Response Editor earlier in this tutorial.

    For event F0, the correct response is the space bar. Choose the blank, the second item in the combo box.
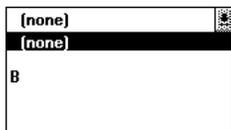
In the upper right corner of the Event Editor dialog, there are two new buttons that you see for the first time: OK, Next and OK, Previous. In addition to being handy editing features, these two buttons make it possible to use the Event Editor in yet another way -- as a way to "browse" through the events.

Let's continue telling SuperLab Pro what are the correct responses for the remaining three events:

1   Click on the OK, Next button. SuperLab Pro will record the changes made to the event being edited and show you the next event to be edited, in this case Lr30.

2   Click on the "Correct response" combo box and choose the blank, the second item in the combo box.

3   Click on the OK, Next button. The next event, F180, will appear.

4   Click on the "Correct response" combo box and choose the blank, the second item in the combo box.

5   Click on the OK, Next button. The next event, Rbl60, will appear.

6   Click on the "Correct response" combo box and choose B.

Finally, click on the OK button; the Event Editor will go away. We have now finished setting up events for this experiment. Chose Save from the File menu to save the experiment.
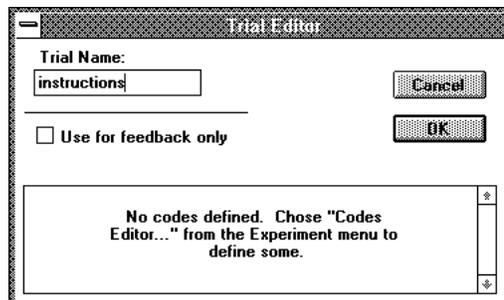
Creating the Trials   As mentioned earlier, an event is the smallest unit of an experiment, and a trial is a set of events. A trial may consist of any number of events. However, you should avoid the common mistake and temptation of including all the events in one trial.

In the case of this experiment, a trial will have only one event in it, and we will give it the same name as an event, for simplicity's sake. To create the five trials:

≡   Click on the list of trials to move the selection rectangle to it and choose Many New Trials from the Edit menu.

≡   In the Trial Editor dialog, you will find a "Use for feedback only" checkbox and a rectangular area where code values would normally appear. We'll come back to these two options in the next chapter.

Trial Editor

Trial Name:

instructions

☐ Use for feedback only

Cancel

OK

No codes defined. Chose "Codes Editor..." from the Experiment menu to define some.

≡   In the edit field, type "instructions." Click on the OK button. The Trial Editor dialog will record the new trial and be ready to accept a new one.

≡   Type "F0" and click on the OK button.

≡   Type "Lr30" and click on the OK button.

≡   Type "F180" and click on the OK button.

≡   Type "Rbl60" and click on the OK button.

≡   Click on the Cancel button.

That's it. You have just created five trials. Chose Save from the File menu to save your work.

Creating a Block   A block is a set of trials, and may contain any number of them. There are no restrictions nor conventions; feel free to organize your experiment however you want. At least one block is required to run the experiment, so let's go ahead and create one:
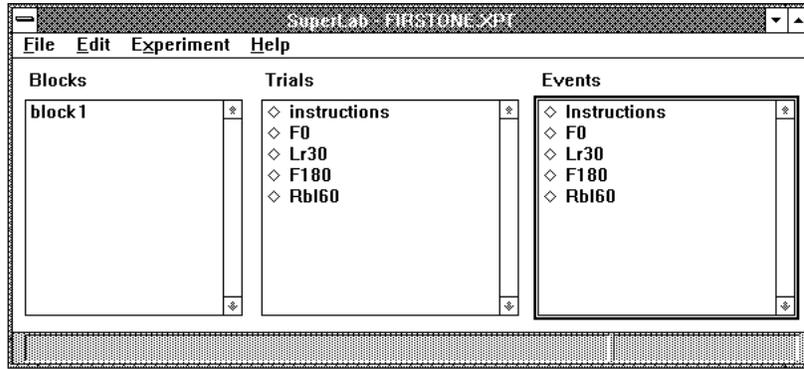
≡   Click on the list of blocks to move the selection rectangle to it and choose One New Block from the Edit menu.

≡   In the edit field, type "block 1."

≡   Click on the OK button.

That's it. You have just created a block. Save your work before proceeding

further. At this point, this is how the Experiment Editor window will look:

We have now created all the elements needed for an experiment, but we are not ready to run it yet. A block is a set of trials, and a trial is a set of events, but how does SuperLab Pro know which trial contains what events?

The Linking Process

Writing an experiment with SuperLab Pro is a two-step process. You have just finished the first step, that of creating the blocks, trials, and events. The next step is linking.

Linking tells SuperLab Pro which trials are included in a block, and which events are included in a trial. The best way to explain links is probably to proceed with an example right away. Keep in mind that, in this experiment, we have only one event per trial.

1   Click on trial "instructions" to select it. Make sure you click on the name itself, not the diamond (◇) preceding it.

2   In the list of events, there are hollow diamonds preceding every event name. Click on the diamond preceding the "Instructions" event. This time, make sure you click on the diamond itself, not the event name. The diamond should turn from hollow (◇) to full (◆).

3   Similarly, click on trial "F0" to select it.

4   Click on the hollow diamond preceding the "F0" event. It should toggle from hollow to full. Stop here for now.

You have just linked two trials to one event each. Trial "instructions" contains the event "Instructions," and trial "F0" contains the event "F0."

This approach to organizing an experiment using links provides flexibility. The number of events or stimuli per trial does not have to be fixed; it can vary within the same experiment. Linking also simplifies other user interface aspects of SuperLab Pro. And finally, links allow the same event to be used in more than

one trial, thus reducing memory requirements and the time it would otherwise take you to set up the same event multiple times.

Before linking the remaining three trials, click on trial "instructions," then click on trial "F0," and click on trial "instructions" back again. While doing this, notice how SuperLab Pro automatically updates the diamonds in the list of events to reflect which events are members of the selected trial.

We still have three trials to link:

1   Click on trial "Lr30" to select it, then click on the hollow diamond preceding the "Lr30" event. It should toggle from hollow to full.

2   Click on trial "F180" to select it, then click on the hollow diamond preceding the "F180" event.

3   Similarly, on trial "Rbl60" to select it, then click on the hollow diamond preceding the "Rbl60" event.

You have just completed linking all trials to all events. Remember to save your work.

There is one last step required before we go ahead and run the experiment: linking blocks to trials. At this point, we have only one block named "block 1," but SuperLab Pro does not know which trials are contained in it. The block-trial links work similarly to trial-event links. In the case of this experiment, all trials are included in "block 1." Here is how to proceed:

1   Click on block "block 1" to select it.

Tip: holding down the Alt key works also with trial-event links; it will toggle all events.

2   Hold down the Alt key on your keyboard, and click on any of the diamonds preceding the trial names. Be careful to click on the diamond itself, not the trial name.

Holding down the Alt key while clicking on a diamond is a SuperLab Pro shortcut that will toggle all diamonds in the list, not just the one you click on.

Trials in a block will always be presented in the same order as they appear in the list, regardless of the order that in which you link them with a block.

Congratulations! You have just completed the linking process and are now ready to run your first experiment. Of course, you did remember to save your work, didn't you?

Running the Experiment

Once the experiment is created, running it is straightforward. From the Experiment menu (on the menu bar), choose Run. A dialog box appears, containing some options. These are discussed later in the "SuperLab Pro Reference" chapter. But for now, leave these options unchanged. Click on the

Run button.

Next, SuperLab Pro will present you with a familiar "save file" box, asking for the name of the results file. You can change the suggested file name if you like. Click on the OK button when ready.

At this point, SuperLab Pro will open a window that covers the entire screen and start displaying the visual stimuli. You can cancel the experiment at any time by pressing the F1 key.

When done, SuperLab Pro saves the collected results to disk and removes the window. If you cancel running an experiment in the middle of it, SuperLab Pro will still save all the data collected up the point when you canceled.

Congratulations, you have just learned how to use SuperLab Pro. The next chapter, "SuperLab Pro In Depth," discusses additional topics. In particular, you are strongly encouraged to read about SuperLab Pro's codes before starting to write your next experiment; they could save you a lot of time.

As for the tutorial experiment you created while going through this chapter, do not delete it yet. It will be used in the next chapter to learn about other features.

Chapter 3 - SuperLab Pro In Depth

This chapter discusses additional topics. It builds on the previous one by using the same sample experiment and tutorial style whenever possible. Unlike the previous chapter however, you do not have to read this entirely, you can read only the section of relevance to your needs. For example, if you are interested in adding feedback to your experiment, see the section "Adding Feedback" only.

The Experiment Editor Window

The main window is where all blocks, trials, and events appear. There are some useful keyboard shortcuts and features that could speed your work if you are familiar with them.

Selecting Multiple List Items

Often, you may need to select more than one block at the same time, or more than one trial or event.

- To select all items in a list, choose Select All from the Edit menu.

- To select multiple contiguous items, click on the first one to select it, hold down the Shift key, then click on the last one. All items between the first one you clicked on and the last will be selected.

- To select "disjoint" items, hold down the Control key while clicking on an item. This will also deselect currently selected items.

If you have a list item selected, e.g. a block, then choose One New Block from the Edit menu and create a new block, the new block will be inserted *before* the currently selected block. If you want to insert a new block at the end of the list, make sure no block is selected before you create the new one. The same applies to trials and events.

Linking Shortcuts

There are some shortcuts you can use when linking. For example, suppose you have an experiment where every trial consists of 3 events, a mask, a cue, and a visual stimulus. All the trials use the same mask and the same cue, but a different stimulus. To speed things, select all the trials in the list then click on the diamonds preceding the cue event and the mask event. This is much faster then selecting every trial and linking it individually.

Another shortcut is to hold the Alt key while clicking on a diamond. This will

toggle all the diamonds in the list from hollow to full or vice versa.

Other Editing Features   Common editing functions can all be accessed from the Edit menu. Many have keyboard equivalents too. Some are obvious, like pressing the Delete key to delete an item. Others may be a little less obvious, like pressing the Enter key to edit selected items; double-clicking on an item also allows for editing. You can also press Tab to move the selection rectangle to the next list or Shift-Tab to move it to the previous list.

If you try to delete an item referred to elsewhere in the experiment, e.g. an event linked to trials, SuperLab Pro will inform you and ask you to confirm whether you want to continue deleting the item. If you do confirm, all references are automatically removed.

When you create a new item, the new item is appended at the end of the list if no item is currently selected. If an item is selected, the new item is inserted before the selected one.

Attaching Codes to Trials

Codes are intended to help you with the post-processing of data collected with SuperLab Pro. The idea is to create codes, give them values, and attach the values to trials. When you run the experiment, the collected data is saved as a plain text file with one line per response. Each line contains the trial number, event number, answer from the subject, reaction time in milliseconds, an error code, *and* the code values attached to the trial. In other words, your data is already pre-coded!

The codes and code values you create could be any alphanumeric string. In the following example, we will create two codes, Speed and Rotation. Speed has three values, fast, medium, and slow. Rotation has 4 values, 0, 90, 180, and -90 (in degrees).
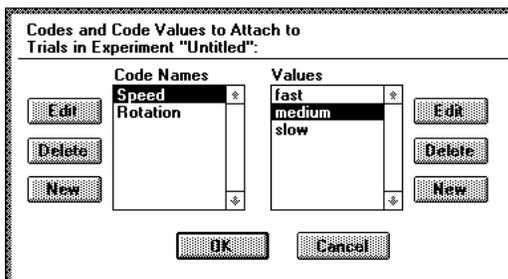
To create the codes and their values, select Codes from the Experiment menu. A window similar to the above appears.

1 Click on the New button to the left. A small dialog appears; type Speed and then click on OK.

2 Similarly, click on the New button to the left again. Type Rotation and then click on OK.

   You have just created the codes.

3 In the Codes Editor window, click on the code Speed to select it. Hold the Alt key down on your keyboard, and click on the New button to the *right*. A small dialog appears.

4 Type the first code value, fast, and click OK. Note that the small dialog disappears and comes back right away. This is because you held down the Alt key before clicking on New. It is a common SuperLab Pro shortcut to speed data entry.

5 With the small dialog still on the screen, type medium and click OK. Type slow and click OK. The dialog box reappears. Click on the Cancel button.

   You have just created the code values for Speed.

6 In the Codes Editor window, click on the code Rotation to select it. Hold the Alt key down on your keyboard, and click on the New button to the right. The small dialog appears.

7 Type 0 (zero) and click OK. The small dialog reappears. Type the other code values the same way, i.e. type 90 and click OK, type 180 then click OK, and type -90 then click OK. When done, click on the Cancel button.

You have just completed the creation of the codes and code values. While the above seems like too many steps, it usually takes less than a minute to create all the code and code values you need.

Now you are ready to "attach" these code values to trials. You can attach them to either existing trials or to new ones. Let us take the example of a new trial:

1 In the Experiment Editor window, click on list of trials to move the selection rectangle to it, the chose One New Trial from the Edit menu. The Trial Editor appears. Note how it lists all the codes just created.

2 Give the trial a name, say "demo trial." Assuming this is a medium speed trial with a picture rotation of 180, click on medium and 180. Click on the OK button.
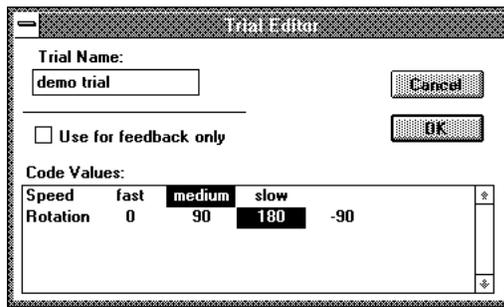
That's it. You have just finished learning how to create and use codes. It is a good idea to plan in advance which codes you would like to use with an experiment, but with SuperLab Pro you can create codes "on the fly" and attach them to trials any time you want. You can also edit and rename the codes and their values at any time without having to reassign them to trials. If you try to delete a code or a code value attached to a trial, SuperLab Pro will issue a warning. If you confirm the warning message and delete, all reference to the deleted code are automatically removed from all trials.

Adding Feedback

SuperLab Pro allows you to add feedback in one of five cases: the subject's response is correct, the subject's response is incorrect, there is no response within a time period you specify, the subject's reaction time is too quick, or the subject's reaction time is too slow. A feedback can be auditory, visual, or both. It is provided to the subject and then the experiment can either proceed with the next event or present the same one again.

Adding feedbacks to your experiment is easy. The steps involved are similar in many ways to setting up trials. In fact, a feedback is an entity very similar to trials. Here is how to go about adding feedbacks:

1 In the Experiment Editor, click on the list of events to move the selection rectangle to it, then chose One New Event or Many New Events from the Edit menu. Create as many events as you will need to present feedbacks.

2 Click on the list of trials to move the selection rectangle to it, then chose One New Trial or Many New Trials from the Edit menu. The trial editor appears. In it, click on the check box "Use for feedback only" and give your feedback a name, e.g. Good feed or Bad feed.
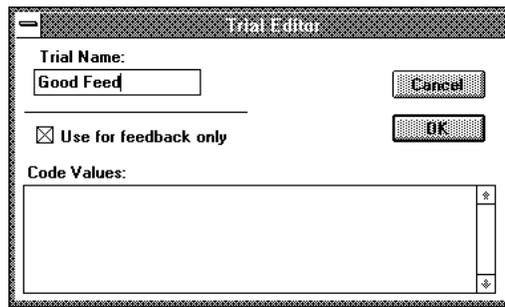
Click on the OK button. In the Experiment Editor, the feedback name is preceded with a delta (△) instead of the hollow diamond (◇). The delta indicates a feedback.

3   Link the necessary events to the feedback, i.e. tell SuperLab Pro which events are included in the feedback you have just created. The linking process should now be a familiar step; it is identical to how you would link events and trials.

The linking process completes the creation of the feedbacks. You still need to add them to the relevant events. It's a simple process:

1   In the Experiment Editor, click on the list of events to move the selection rectangle to it, select the event you want to add a feedback to, then chose Edit Event from the Edit menu. The Event Editor appears.

2   Click on the Feedback button to switch to the Feedbacks property sheet.

To add a feedback to an event, turn on the checkbox for the type of feedback you want. For example, to add feedback for cases when the response is incorrect, turn on the checkbox "Incorrect" then chose one of the feedbacks you have created from the combo box next to that checkbox.

To speed things, you can also select more than one event at the same time, choose Edit Event from the Edit menu, and add feedbacks to all of them at the same time.

The Feedback property sheet of the Event Editor is described in more detail in the "SuperLab Pro Reference" chapter.

Additional Facts About Feedbacks

The Feedbacks property sheet contains two combo boxes at the bottom of the dialog that give you control over priority of feedbacks and the flow of the experiment.

The first combo box gives you control over feedback priority. For example, if you chose to provide feedback to the subject when the response is both incorrect and reaction time too slow, you can instruct SuperLab Pro which event takes priority when both eventualities occur. This combo box is automatically disabled (turned

gray) when it does not apply.

The second combo box instructs SuperLab Pro what to do after an event has been presented. It can either proceed with the next event (or the next trial if necessary), or present the entire trial again. SuperLab Pro ignores this combo box if the feedback is for correct responses.

Please note that an event that is itself part of a feedback cannot have feedbacks; if a feedback is set, it will simply be ignored.

Another fact to be aware of is the interaction between a time limit placed on an event and feedback when there is no response. If you chose to use both features at the same time, no feedback will be provided if the time limit expires first. On the other hand, if the feedback's timeout period occurs before the time limit expires, the feedback will then be provided.

Chapter 4 - On Timing And Input

This chapter discusses the crucial issue of timing, how SuperLab Pro does it, what you can do to help improve it, and other details related to using a particular input device or timer. Other topics that affect the accuracy of timing are also discussed here.

At Cedrus, we designed SuperLab Pro to be friendly yet powerful, and we are trying to keep its manual as clear as possible, eliminating the unnecessary "computerese" whenever possible. Unfortunately, when discussing timing, we have to introduce some computer concepts as well as some Windows-specific information.

Please note also that it is possible to extend SuperLab Pro and build your own timer and input modules using SuperLab SDK. The documentation for SuperLab SDK is available on the distribution diskette in electronic form, but we recommend that you visit our web site for the latest version and information.

☞ If you are serious about timing, it is suggested you read this chapter in its entirety. No single section in it will give you the whole picture.

Timing Options

SuperLab Pro currently provides two options to perform timing: TickCount and Multimedia.

TickCount Timer   This is the PC's "standard" timer; it has been around since the very first IBM PC introduced in 1981. It gets incremented every 55 milliseconds. This is not a recommended timer!

Multimedia Timer   With the increasing popularity of multimedia applications in the early 1990s, Microsoft released the multimedia system extensions, which later became standard issue starting with Windows 3.1 and later releases. These extensions include a timer that ticks every 1 millisecond on most machines; SuperLab Pro will tell you what is the resosultion on your particular machine. For example, on some IBM ThinkPad models, the Multimedia Timer ticks every 2 milliseconds.

Unless you are using a hardware-based timer, the Multimedia Timer is the one you should be using for all your experiments.

Input Options

Deciding which input option to use is as important as the choice of timer, since it is the combination of both that determines accuracy. There are currently several choices with more being added all the time (visit the Cedrus web site for updates). Current choices are the keyboard, mouse, Cedrus response boxes, and 4 different i/o card models from two different manufacturers. Support for the i/o cards is not included with SuperLab Pro.

☞ A current limitation is that SuperLab Pro cannot check for input from the subject while a visual stimulus is being drawn. This will be remedied in a release of software and/or hardware.

Generic Keyboard   This is basically any PC keyboard. The timing resolution using the keyboard has not been tested yet. If you are using SuperLab Pro for research, Cedrus strongly recommends using an external response box via the serial port or an i/o card. The Generic Keyboard input module may be allright for teaching purposes, but it is not recommended for studies requiring accurate reaction time measurements.

The Generic Keyboard allows up to 64 responses, each having from 1 to 11 characters.

Generic Mouse Buttons
MS Mouse Buttons   These two input modules support the mouse buttons. Each has advantages and disadvantages. The Generic Mouse Buttons module can use the standard mouse used everyday but cannot guarantee one millisecond resolution. The MS Mouse Buttons module requires a second, Microsoft-compatible serial mouse but gives you one millisecond resolution.

See the online help file for more complete information.

ViaPort   The ViaPort is a low cost i/o card that connects to the computer's serial port. It provides unique features that avoid the delay inherent in transmitting information via the serial port.

The ViaPort is still in development as of this writing. Please visit our web site at http://www.cedrus.com/hardware for the latest information.

CIO-DIO24 Card   SuperLab Pro supports the CIO-DIO24 low cost i/o card using the *CIO-DIO24*

Support Pack, an add-on product available from Cedrus. This card has 24 lines that may be used for either input or output; it plugs into a standard ISA slot. SuperLab Pro supports up to 8 lines for input and 8 lines for output. This card is accessed very quickly, well under one millisecond. For details, see the Cedrus web site at http://www.cedrus.com/hardware.

Please see the section "Debouncing Time" below.

National Instruments Card

SuperLab Pro supports the National Instruments LabPC, PC-LPM-16, and PC-TIO-10 card using the *LabPC Support Pack Standard Edition*, a free add-on product available from Cedrus. It is available for download from the Cedrus web site at http://www.cedrus.com/superlab. Click on the "archives" link.

These cards plug into a standard ISA slot. SuperLab Pro supports up to 8 lines for input and 8 lines for output. For input, the card is accessed very quickly, well under one millisecond.

Please see the section "Debouncing Time" below.

RB-400 Response Box
RB-600 Response Box

These two input modules support the RB-400 and RB-600 response boxes from Cedrus. They are high quality, microprocessor-controlled response boxes. The RB-400 has four pushbuttons and the RB-600 has six. They connect to the computer using one serial port. Visit the Cedrus web site (http://www.cedrus.com) or contact us for more information.

The microprocessor in these response boxes automatically takes care of switch debouncing. Please see the section "Debouncing Time" below for more information.

Debouncing Time

If you decide to build your own response box, take particular care about the choice of pushbuttons the subject is going to use. When pressed, almost every switch "bounces," that is, closes the electric contact and reopens it several times for a short period. This is usually too quick to be noticeable, but it does happen. The better the switch quality, the shorter the bouncing period will be.

To get around this problem, a number of input modules let you set a "debouncing time," a period of time during which all input from the subject will be ignored after a pushbutton is pressed. To illustrate the problem, set the debouncing time to zero and run an experiment. In the collected data file, chances are good you will see several records (lines) for each response. Keep increasing the debouncing time until you no longer see multiple records per response.

Please note that the debouncing time period is "waited out" only when the

subject responds incorrectly and the input module has to look for another response for the same event. If the subject responds correctly and SuperLab Pro proceeds to the next event, the debouncing time is ignored.

The Cedrus RB-400 and RB-600 response boxes take care of the switch debouncing themselves.

Recommended Input Device

The recommended input device is either a response box, mouse, or the ViaPort. Cedrus will keep looking into ways to obtain better accuracy from the keyboard; however, early research into this issue has not been very encouraging.

How a Visual Stimulus is Drawn

The section and the rest of this chapter discuss visual stimuli drawing times. It helps explain some of the variability in drawing times and what you do to help reduce them.

The section provides a quick introduction to video monitors technology. It will help you understand why, even though SuperLab Pro's timers are accurate to within a millisecond, a visual stimulus is not drawn within a millisecond. Even if you feel you know enough about the subject, it is a good idea to go through it quickly to ensure the terminology is consistent in subsequent sections.

Video Monitors Primer

Video monitors used in today's computers are a quantum leap improvement over storage tube displays so common in the sixties and seventies. The smallest unit of information that can be displayed by a monitor is the *pixel*, a small dot on the screen. The word pixel is an abbreviation of "PICture Element." A monitor represents its information using rows and columns of pixels that can be turned on or off at will. These rows and columns are often referred to as a *raster*.

The illustration above shows a magnified raster. All pixels in it are turned off except for a few that are cleverly aligned to form the letters a, b, and c, and a line. When a computer is instructed to draw a line from one point to another, it has to perform a series of calculations to decide which pixels to turn on. This is referred

to as *rasterization*, a computing process that takes time. Rasterizing the same line twice in a row could take a different amount of time, depending on whether your computer has a RAM cache. More on that a little later.

From the inside, a video monitor contains a "gun" shooting electrons at the screen. The inside of the screen has a phosphorous coating. When hit by the electrons, the phosphorous coating produces light, and a pixel is seen turned on. By turning enough pixels on, a picture and/or text forms on the screen.

This approach to displaying information provides great flexibility. But there is one catch: if the gun inside the monitor stops shooting electrons at the pixel location on the screen, the phosphorous coating will no longer emit light and the pixel will fade away. To get around this, a computer instructs the electron gun to shoot at a given location on the screen several times a second, typically 60 to 120 times per second. This operation is known as *refreshing*, or video refresh, and is very important to understanding how SuperLab Pro and other software draw visual stimuli.

Video refreshing raises yet another issue: how does the computer know which pixels are supposed to be on? As you are well aware, every computer comes with memory, the famous RAM you keep hearing about. To make video refreshing a reality, the computer must have *video memory*. On most modern computers, video memory is physically different from the main memory. In some cases, the computer simply sets aside a portion of the main memory. But in all cases, the status of a pixel on the screen is always remembered in memory.

When refreshing occurs, i.e. when the computer is redrawing the image on the screen, the electron gun goes from top to bottom, from one side of the screen to the other. Because of this, the electron gun is often referred to as the *refresh beam* or *refresh line*. One complete scan from top to bottom is known as the refresh *cycle*. More cycles per second are better because they result in less flicker and a better picture. The number of cycles per second is often expressed in Hz (pronounced Hertz). For example, a 60 Hz video monitor has its image refreshed sixty times per second.

A bit is the smallest unit of information. It has two states, 0 or 1. For black and white monitors, only one bit per pixel is needed. For color monitors, we need more bits per pixels, depending on the maximum number of colors that can be displayed at any one time. For example, a 16 color monitor requires 4 bits for each pixel, a 256 color monitor requires 8 bits for each pixel. As you can see, the more colors you use, the you more video memory is needed. But the highest price is paid in speed because more colors mean more memory needs to be manipulated and moved around.

Video Monitors and SuperLab Pro

The problem with drawing a visual stimulus is speed. Based on the discussion above, the best one can do is draw a stimulus within one refresh cycle. Even if the computer takes only one or two milliseconds to draw the picture, it will still take a refresh cycle for the picture to appear. But if a picture takes a long time to draw, it will be many refresh cycles before the computer is done drawing it. To help reduce drawing time to just one cycle, try reducing the number of colors your monitor is set to or reducing the size of your stimuli, if this is an option. Also, for both the Picture File and Text events, make sure you always use the offscreen buffering option.

What's in a Cache?

If you already know what RAM cache and font cache are, feel free to skip this section and go to the next one, "Taking Advantage of Cache."

Earlier in this section, we mentioned a RAM cache. A cache is usually a big culprit in introducing variability to the drawing time of a visual stimulus. But what is it?

A cache is a temporary storage area that speeds access to information. It can be implemented in many different ways. Let's take the case of accessing information from a hard disk. A disk is a mechanical device, always slower than an electronic one. But programs often access the same parts of a disk. It seems silly to have to read the same thing over and over again when it can be stored temporarily in RAM memory and accessed much faster from there. So computer designers set aside a portion of RAM memory to act as a *disk cache*, i.e. a temporary storage area to speed access to the disk. So why does a cache introduce variability? Because the first time you try to access information, the computer looks to see if it's in the cache already. If it is, it fetches it from there; if it is not, it fetches from the hard disk and stores a copy in RAM. The next time you try to access the same information and it happens to still be in the cache, the computer will fetch it from there, and it will do it faster than it did the first time when it had to go to the disk. The keyword here is "faster," meaning variable.

Please note that a disk cache does not affect SuperLab Pro's drawing of visual stimuli; the only reason it is mentioned here is because it's the easiest to explain. There are however two other caches that do affect stimulus drawing: RAM cache and font cache.

In the example just mentioned, RAM memory is used to speed access to a slower device, the disk. But what happens if the processor has become so fast (as is the case today) that even RAM memory itself has become too slow for it? The solution is to introduce a *RAM cache*, memory that is physically different (and several times more expensive) from the rest of the RAM memory. When the processor tries to access RAM, it looks first in the cache and fetches it from there if it finds it. If it does not, it accesses the slower RAM.

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If your computer has a RAM cache, you can usually tell by previewing a picture without using the offscreen buffering option. The second time you preview it, it is displayed a little faster than the first time.

Remember we uttered the word "rasterization" earlier? We used it to show how a line is converted from two coordinate points to a series of pixels to be turned on. A similar rasterization process happens when trying to display fonts. In Microsoft Windows, there are two main types of fonts: raster and TrueType. Raster fonts are bitmap representations of characters; every character is basically a small bitmap. Raster fonts do not have or cause much variability in drawing time, but have the disadvantage of scaling poorly: they look good only in the sizes provided by the font designer.

TrueType fonts use straight lines and curves that define the outline of each character. When wanting to display a character, the computer has to convert these line and curve definitions to a bitmap, i.e. it has to rasterize the character. This is a slow process because a lot of math is involved. This bitmap is then stored in a *font cache*. The next time the computer tries to draw the same character, it will rasterize it only if it cannot find its representation in the font cache.

A font cache introduces the wildest variability. Try creating an event of type Text and use a TrueType font (e.g. Arial) using a large size, e.g. 96. Turn off the offscreen buffering option and click on the Preview button. Note the preview time on the bottom left of the screen, then press any key to go back to the Event Editor. Now preview again, and you are likely to see a preview time significantly less than the first one. This is because of the font cache.

Taking Advantage of Cache

As explained above, a cache can speed things up, but at the cost of introducing a variability in drawing time. You can greatly reduce the variability by using the offscreen buffering option whenever available. If you do, you can benefit from SuperLab Pro's design which takes maximum advantage of a RAM cache while reducing variability further, all at the same time. Here is how it works.

Suppose you have a trial that consists of 2 events, the first one is a picture and the second is a text. Both have offscreen buffering enabled. SuperLab Pro creates the offscreen buffers just before the trial is about to run. This maximizes the chance that one or more offscreen buffer will still be in the cache when SuperLab Pro copies it to the main screen. To increase this likelihood even further, SuperLab Pro creates the offscreen buffers in reverse order. In the case of our example, the text (second event in the trial) will be drawn to an offscreen buffer first, then the picture is drawn offscreen. Most modern Pentium computers have 128 kilobytes of RAM cache or more. Chances are high that at least one offscreen buffer would fit in the RAM cache and stay in it long enough to be read back and copied to the main screen.

Chapter 5 - SuperLab Pro Reference

This chapter forms a reference to all of SuperLab Pro menus and editors. Let's start with the editors and dialogs, in the order you would use to build and run an experiment.

The Response Editor

A response, in the context of SuperLab Pro, is a possible answer to a stimulus. For example, an experiment may accept only one of two answers, yes or no; on the keyboard, this can be represented with the keys Y or N; on a response box, this can be represented with one of two buttons.

When you chose Responses from the Experiment menu, you get a Response Editor similar to the one picture below. However, if your input module is other than the keyboard, the Response Editor may look different. Using the keyboard, you can define up to 64 responses, each having from 1 to 11 characters. For other input devices, see the chapter "On Timing And Input."

The Response Editor allows you to add, edit, and delete responses for the experiment. To select a response, simply click on it.

≡ To add a new response, click on the New button; the new response is appended at the end of the list. To create more than one response faster, hold down the Alt key while clicking on the New button; this will cause SuperLab Pro to prompt you for new responses until you click Cancel.

≡ To edit an existing response, select it then click the Edit button, or double-click on the response itself. The responses are not case sensitive, meaning that SuperLab Pro does not distinguish between upper and lower letters.

≡ To delete a selected response, click the Delete button, press the Delete key on your keyboard, or select Delete from the Edit menu.

≡ Click on OK to confirm the changes or Cancel to ignore them.
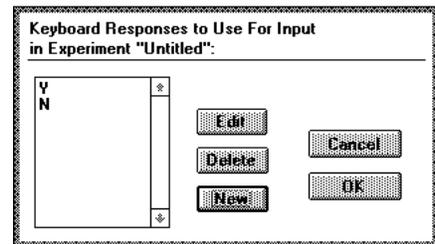
If you try to delete a response referred to by an event elsewhere in the experiment, SuperLab Pro will warn you and ask you to confirm whether you want to go ahead. If you do confirm, all events making use of this response will have their correct response set to "None," even if you later click on the Cancel button to have the changes ignored.

The Codes Editor

SuperLab Pro codes are of no use for the purpose of administering the experiment itself; they come into play later, once you are through with running the experiment. The idea is to be able to attach one or more codes to each trial, and use them later in the analysis of the results.

A code can have a number of values; for example, a code named Difficulty may have one of three values, easy, medium, or hard. Another code named Cue can have just two values, valid or invalid.

Taking advantage of codes is a two-step process. One, use the Codes Editor to define all the codes and their values. Two, edit the trials to attach code values to them. Later, when you administer your experiment, these code values will appear in the results file that SuperLab Pro saves.

The following picture illustrates what the Codes Editor looks like. In it, we have defined the two codes mentioned above, Difficulty and Cue. The codes are listed on the left, their values on the right:

≡ To create a new code, click on the New button on the left.

Tip: if you hold down the Alt key while clicking on New, SuperLab Pro will keep prompting for new codes or code values until you click Cancel.

≡ To create a new code value, select the desired code then click on the New button to the right.
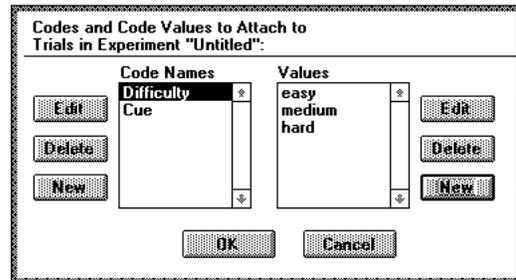
≡ To view different code values, click on the code name itself. In the illustration above, for example, clicking on the code Cue will automatically list its values on the right side.

≡ To delete a selected code, click the Delete button on the left. This will also delete all the values associated with it.

≡ To edit an existing code, select it then click the Edit button on the left, or double-click on the code name itself.

≡ To delete a selected value, click the Delete button on the right.

≡ To edit an existing value, select it then click the Edit button on the right, or double-click on the value name itself.

You can edit the codes and their values at any time without having to reassign them to trials. If you try to delete a code value already referred to by a trial elsewhere in the experiment, SuperLab Pro will warn you and ask you to confirm whether you want to go ahead. If you do confirm, all trial references to the code value will be removed, even if you later click on the Cancel button to have the changes ignored.

You can create up to 20 codes, and each code can have up to 10 values. The code name may contain from 1 to 15 characters. A code value can contain from 1 to 7 characters.

For details on how to associate the code values with a trial, see the section "Attaching Codes to Trials" in chapter 3.
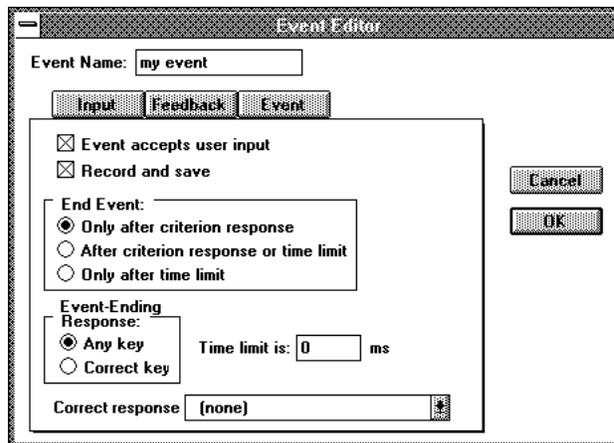
The Block Editor

The Block Editor permits the creation of new blocks or the editing of existing ones. To create a new block, click on the list of blocks in the main experiment window to move the selection rectangle, then choose One New Block from the Edit menu. To edit an existing block, click on it to select it, then either press the Enter key or choose Edit Block from the Edit menu; you can also double-click on the block.

The Block Editor lets you change the block name and trial randomization parameters.

≡　To create a new block or change the name of an existing one, type its name in the edit field. Block names must be unique.
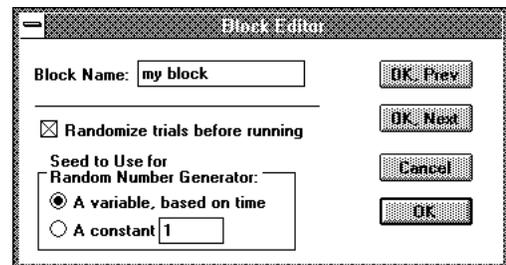
≡　SuperLab Pro can randomize trials on a per block basis. It is as simple as turning on or off the "Randomize trials before running" checkbox

≡　If you turn trial randomization on, SuperLab Pro will need a seed for the random number generator function. In most cases, you will want SuperLab Pro to choose its own seed based on time; for that, click on the "A variable, based on time" radio button. If you want to supply your own seed, click on the "A constant" radio button and enter any value greater than 1.

Choosing a constant seed value results in the same random sequence every time. This feature is typically used in cases when the experimenter has a large subject population and wants to provide groups of subjects with the same sequence.

The Trial Editor permits the creation of new trials or feedbacks, or the editing of existing ones. To create a new trial or feedback, click on the list of trials in the main experiment window to move the selection rectangle, then choose One New Trial from the Edit menu. To edit an existing one, click on it to select it, then either press the Enter key or choose Edit Trial from the Edit menu; you can also double-click on the trial or feedback.

The Trial Editor lets you change the trial name and the code values attached to it. This is described in the "SuperLab Pro in Depth" chapter.

The Event Editor permits the creation of new events or the editing of existing ones. To create a new event, click on the list of events in the main experiment window to move the selection rectangle, then choose One New Event from the Edit menu. To edit an existing one, click on it to select it, then either press the Enter key or choose Edit Event from the Edit menu; you can also double-click on the event.

The Event Editor is divided into three property sheets (also called sections). These are Input, Feedback, and Event. You selected the desired property sheet by clicking on the corresponding button.

The Input Property Sheet

The Input property sheet is where you tell SuperLab Pro how the event should interact with the subject.

≡ The "Event accepts user input" checkbox determines whether input is accepted at all from the subject. If you turn it off, SuperLab Pro will present the event and proceed with the next one.

≡ The "Record and save response" determines whether SuperLab Pro should save the subject's response to disk. It will not if this checkbox is turned off. This feature helps reduce clutter in the collected data file by not recording responses to certain events like instruction screens or digital output pulses.

≡ There are three ways to terminate the response. The first one is only after a criterion response. The second is after either a criterion response or a time limit, whichever occurs first. The third is only after a time limit, even if the subject responds correctly. Choose the corresponding radio button.

≡ If ending the event involves a time limit, enter what the time limit is, in milliseconds.

≡ A "criterion response" is the event-ending response, and can be either any key or only the correct key.

≡ If the criterion response is the correct key, you need to tell SuperLab Pro what the correct key actually is. You can do that using the "Correct response" combo box. The first item in that combo box is (none). The remaining items are responses defined separately using the Response Editor.

The Feedback Property Sheet The Feedback property sheet is where you tell SuperLab Pro how to react to input from the subject. To create feedbacks, you must do that separately using the Trial Editor. For an introduction to using feedbacks, see the "SuperLab Pro in Depth" chapter.

≡ To provide a feedback based on whether the subject's response is correct, turn on the "Correct" checkbox then choose the feedback from the combo

box next to it.

≡ To provide a feedback based on whether the subject's response is incorrect, turn on the "Incorrect" checkbox then choose the feedback from the combo box next to it.

≡ You can provide feedback for cases when the subject remains idle for too long. To do that, turn on the "No response within" checkbox, enter the time limit, then choose the feedback from the combo box next to it.

≡ To provide a feedback based on whether the subject's reaction time is too quick, turn on the "Less than or equal to" checkbox, enter the time limit, then choose the feedback from the combo box next to it.

≡ To provide a feedback based on whether the subject's reaction time is too slow, turn on the "Greater than" checkbox, enter the time limit, then choose the feedback from the combo box next to it.

Should SuperLab Pro have to provide a feedback, there are two additional options to give you more complete control over feedback:

≡ Once a feedback is provided, you can use the "After presenting" combo box to decide if the same trial should be presented again, or whether you would like to proceed with the next event.

≡ Suppose you have set up an event to provide feedback when reaction time is too slow and when the response is incorrect. What if the subject responds both slowly and incorrectly? The "Feedback Priority" combo box lets you determine which type of feedback has priority.

These two combo boxes are enabled and disabled automatically based on your current selection of feedbacks. Generally, you will find it that it makes sense why a combo box disabled.

However, there is one case where the "After presenting" combo box is disabled in a way that may not make sense at first. This happens if you choose both the "Greater than" and the "Less than or equal to" feedbacks. In this particular case, the "After presenting" combo box is disabled and its value is set to "Proceed normally." This is because if you set the combo box to "Present same trial again," your experiment will go into an endless loop.

The Event Property Sheet

The Event property sheet is where you control what to present to the subject and how. Click on the Event Type combo box; it shows five types of events. When you select one of them, the contents of the dialog box change. The different types of events are described below. Check the online help file if the description of an event type is not found in this manual.

Please note that the Event Type combo box may show more or less types of events than described here. This is because SuperLab Pro has a "plug-in"

architecture; events are external programs that "plug" into the main program. When you first run SuperLab Pro, the program looks in the "superlab\plug-ins" directory for plug-in modules and loads them.

When you switch to the Event property sheet, additional dialog items may appear, like the File and Preview buttons. These button are automatically enabled or hidden based on which type of event you choose.

Event – Picture File

The Picture File event type allows you to display any Microsoft Windows bitmap (.BMP) file as visual stimulus. Practically every graphic and drawing software for Microsoft Windows can save in the .BMP file format. Once opened from within SuperLab Pro, you can control the picture's position on the screen and how it is presented. The visual stimulus could be anything: text, graphics, black and white, color, hand drawn, or digitized.
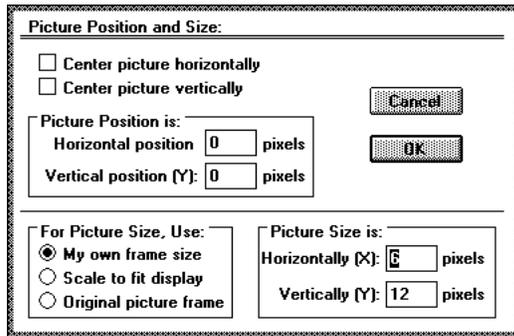
The Picture File event type consists mainly of two buttons and a thumbnail (mini view) representation of the bitmap.

≡ To open a bitmap file, click on the File button. A familiar "open file" dialog appears; locate the bitmap file and click on the OK button.

≡ To preview a bitmap file, click on the Preview button. SuperLab Pro displays the bitmap exactly as it would be presented to the subject and shows how long it took to draw at the bottom right of the screen. If you had the "Draw grid" checkbox turned on, a grid is also drawn.

It is a good idea to preview after you change a bitmap's size or position on the screen. When you first run SuperLab Pro, it defaults to centering the picture both horizontally and vertically on the screen. If you change the position and/or size, these new values become the default for bitmaps loaded later.

Editing Position and Size   Once a bitmap has been opened in SuperLab Pro, you can edit its position and size without having to go back to the graphics package that created it. Click on the Pos. & Size button; a dialog similar to the next one appears:
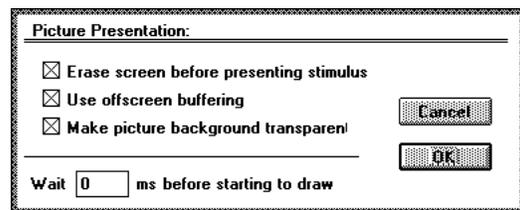
Picture Position and Size:

☐ Center picture horizontally
☐ Center picture vertically

Picture Position is:

Horizontal position   `0`   pixels

Vertical position (Y):   `0`   pixels

       Cancel

       OK

For Picture Size, Use:

◉ My own frame size
○ Scale to fit display
○ Original picture frame

Picture Size is:

Horizontally (X):   `6`   pixels

Vertically (Y):   `12`   pixels

≡   To have the picture centered horizontally automatically, turn on the "Center picture horizontally."

≡   To have the picture centered vertically automatically, turn on the "Center picture vertically."

≡   If you do not want the picture centered automatically either horizontally or vertically, you can specify its position on the screen. The position is measured from the center of the screen to the center of picture, in pixels.

≡   To use the picture's original dimensions, click on the "Original picture frame" radio button. SuperLab Pro will show the picture's dimensions in pixels in the Picture Size edit fields on the right.

≡   "Scale to fit display" will scale the picture appropriately to fit the entire screen. SuperLab Pro will show the display's dimensions in pixels in the Picture Size edit fields on the right.

≡   To specify any other picture dimension, click on the "My own frame size" radio button and enter the vertical and horizontal dimensions in the Picture Size edit fields on the right.

Controlling Picture Presentation

In addition to position and size, there are other parameters you can control. Click on the Presentation button; a dialog similar to the next one appears:

≡   If the "Erase screen before presenting stimulus" checkbox is checked, the screen will be erased before the stimulus is presented. If unchecked, the screen will not be erased, allowing you

Picture Presentation:

☒ Erase screen before presenting stimulus
☒ Use offscreen buffering
☒ Make picture background transparent

     Cancel

     OK

Wait   `0`   ms before starting to draw

to overlay multiple visual stimuli on the screen at the same time.

≡   If the "Use offscreen buffering" checkbox is checked, SuperLab Pro will create an offscreen buffer at run-time, copy the picture to it, than copy the contents of the offscreen buffer to the screen. Use of this feature is recommended.
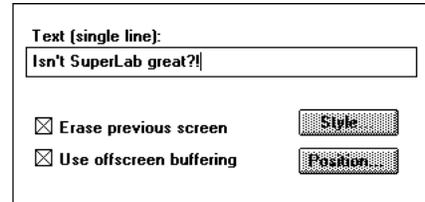
- If the "Make picture background transparent" checkbox is not checked, a picture drawn on the screen will overwrite everything within its own frame.

- The "Wait nnn ms before starting to draw" feature allows you to add a lead time before a picture is drawn.

Event – Text

The Text event type allows you to present words or single-line sentences as visual stimuli. SuperLab Pro gives you control over font, size, style, color, and position on the screen.
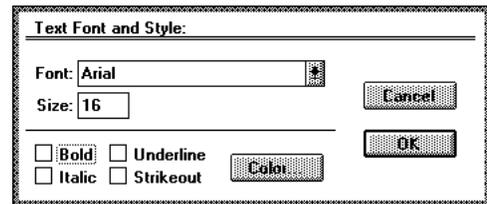
- If the "Erase previous screen" checkbox is checked, the screen will be erased before the text is pre-sented. If unchecked, the screen will not be erased, allowing you to overlay multiple visual stimuli on the screen at the same time.

  > Text (single line):
  > Isn't SuperLab great?!
  >
  > ☒ Erase previous screen   Style
  > ☒ Use offscreen buffering   Position...

- If the "Use offscreen buffering" checkbox is checked, SuperLab Pro will create an offscreen buffer at run-time, draw the text in it, than copy the contents of the offscreen buffer to the screen. Use of this feature is highly recommended.

Editing Style To change any of the text's attributes, click on the Style button; a dialog similar to the one on the right appears. This dialog is rather straightforward; four checkboxes give you control over attributes such as bold, italic, underline, and strikeout.
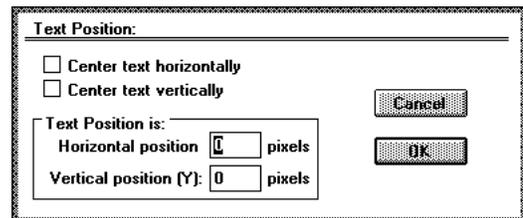
> Text Font and Style:
>
> Font: Arial
> Size: 16
>
> ☐ Bold   ☐ Underline
> ☐ Italic ☐ Strikeout   Color
>
> Cancel
> OK

Click on the Color button to change the text color. Use the Font and Size combo boxes to change font and size.

Editing Position You can edit the text's position. Click on the Position button; a dialog similar to the one on the right appears.

> Text Position:
>
> ☐ Center text horizontally
> ☐ Center text vertically
>
> Text Position is:
>   Horizontal position [0] pixels
>   Vertical position (Y): [0] pixels
>
> Cancel
> OK

- To have the text centered horizontally automatically, turn on the "Center text

horizontally."

☰ To have the text centered vertically automatically, turn on the "Center text vertically."

☰ If you do not want the text centered automatically either horizontally or vertically, you can specify its position on the screen. The position is measured from the center of the screen to the center of text string, in pixels.

Event – Digital Output

SuperLab Pro supports output from i/o cards and the ViaPort. The Digital Output modules in the *LabPC Support Pack* and the *CIO-DIO24 Support Pack* function identically. You can generate a pulse, raise a digital output line (turn line on), or lower the line (turn line off).

By convention, on all the supported i/o cards port A is used for input and port B is used for digital output.

To choose the lines on which pulses will be going out, type it in the edit field. Valid values are 0 (no lines) to 255 (all lines at the same time). The table below will help you select the values appropriate for each line:

```
For line #          The value is
     0                    1
     1                    2
     2                    4
     3                    8
     4                   16
     5                   32
     6                   64
     7                  128
```

To output pulses on more than one line at the same time, simply add the matching values. For example, to output a pulse on lines 3 and 6, type the value 72 (8+64).

☰ To choose whether you want to generate a pulse, raise a line, or lower a line, click on the appropriate radio button.

☰ To set the pulse's duration, type it in.

- If generating more than one pulse, set the inter-pulse interval

- In the last edit field, type how many pulses are generated for the event.

- Click on the Test button to generate a sample output pulse, raise a line, or lower a line.

The Source combo box lets you choose which digital output lines you want to control. The contents of this box will change depending on which *Support Pack* you have.

The File Menu

The File menu allows you to perform all file-related functions such as creating a new experiment, opening an existing one, and saving. Keep in mind that only one experiment may be loaded at any one time.

The following describes items in the File menu.

New

Creates a new experiment. If there is an experiment currently loaded and changes made to it have not been saved, SuperLab Pro will remind you to save the changes.

Open...

```
File
New
Open...    Ctrl+O
Close

Save       Ctrl+S
Save As...

Exit
```

Presents the standard "open file" box. Click the OK button to load the experiment, or Cancel. If there is an experiment currently loaded and changes made to it have not been saved, SuperLab Pro will remind you to save the changes.

Loading an experiment takes place in two stages. First, the experiment itself is read, translated (parsed), and checked for errors. Next, all the picture and sound files described in the experiment get either loaded into memory or located on the hard disk, depending on the memory mode you have set in the Preferences dialog. If, for one reason or another, SuperLab Pro cannot find a given file, it will present you with the standard open file box again and ask you to locate it.

Close

If you have made changes that are not saved yet, SuperLab Pro will remind you to save the changes.

Save

Saves changes you made to the experiment currently loaded. If this is the first time you are saving the experiment and you have not given it a name yet, you will be presented with the standard "save file" box.

■　**Save As...**

SuperLab Pro presents the standard "save file" box and saves a copy of the current experiment with a new name you specify. Subsequent uses of Save (as opposed to Save As...) will save changes you make to this new experiment.

■　**Exit**

Exits the program. If there is an experiment currently loaded and changes made to it have not been saved, SuperLab Pro will remind you to save the changes.

The Edit Menu

The Edit menu performs standard Windows editing functions you are already accustomed to such as Cut, Copy, and Paste, as well as SuperLab Pro-specific editing such as creating new items, and editing existing ones.

Many items in this menu are disabled (grayed) or enabled depending on whether a list item is selected. A list item is a block, a trial, or an event. Cutting, copying, or deleting a block will also operate on its links. For example, if you cut a block that has 3 trials linked to it, pasting it back will also restore the links to these 3 trials.
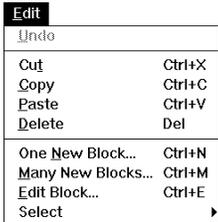
Edit	
Undo	
Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Delete	Del
One New Block...	Ctrl+N
Many New Blocks...	Ctrl+M
Edit Block...	Ctrl+E
Select	▶

When you Cut or Copy an item, you are limited to a fixed-size 10 kilobytes buffer, which is plenty for most needs. SuperLab Pro places the contents in the Clipboard as straight text, in the same format used to save the experiment to disk. This makes it possible to cut-n-paste not only within SuperLab Pro, but also between SuperLab Pro and other applications.

The following describes items in the Edit menu.

■　**Undo**

Not implemented in this release of SuperLab Pro.

■　**Cut**

Makes a copy of the currently selected items and places it in the Clipboard, and then deletes them.

■　**Copy**

Makes a copy of the currently selected items and places it in the Clipboard.

■　**Paste**

Pastes the Clipboard contents into the experiment. The Clipboard contents are pasted in "insert" mode. For example, suppose you used Cut or Copy to place 4 trials in the Clipboard. When you Paste, SuperLab Pro will append the 4 trials after all the existing ones if no trial is currently selected. But, if at least one trial is

selected, SuperLab Pro will insert the 4 trials currently in the Clipboard just before the first selected trial.

Pasting in insert mode makes it possible to use Cut/Copy/Paste to change the order of items in the experiment.

As discussed earlier, the event, trial, and block names must be unique. For example, an event can have the same name as a trial, but no two events may have the same name. To help keep this straight, SuperLab Pro makes sure the items being pasted have a unique name. It does so by adding a number at the end if none already exists, or by incrementing the existing one. For example:

```
Trial 1          gets pasted as     Trial 2
the trial        gets pasted as     the trial1
event 589        gets pasted as     event 590
```

This method of pasting can also be used to create experiment items quicker. For example, to create 80 items, create the first one, copy it, and then paste it 79 times. It is much faster to create the trials this way then to create them individually and type the name of each.

■ Delete

Tip: if you hold down the Alt key while selecting Cut or Clear, SuperLab Pro will not confirm the deletion. Use with care!

Deletes the currently selected items. You can also use the Delete key on your keyboard.

If you are cutting or deleting an item referred to elsewhere in the experiment, SuperLab Pro will tell you so and confirm whether you want to go ahead. Examples are an event linked to a trial or a trial linked to a block.

Since the current release of SuperLab Pro does not implement the Undo feature, be careful when you delete items.

■ One New <Item>...
■ Many New <Items>...

These menu items allow you to add a new block, a new trial, or a new event. The only difference between the two is that Many New <Items> will keep the relevant editor on the screen until you click on the Cancel button, thus facilitating the creation of multiple items.

■ Edit <Item>...

Edits the currently selected item. For blocks and trials, only one item can be edited at the same time. For events, you can edit as many events as you want all at the same time.

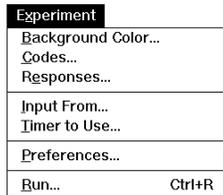### ■ Select All

Selects all the items in a list.

■ **Select None**

Deselects all the items in a list.

The Experiment Menu

The Experiment menu lets you edit miscellaneous aspects of the experiment such as background color, codes, responses, input method, timing method, and miscellaneous preferences. You also use the Experiment menu to run an experiment.

Experiment
Background Color...
Codes...
Responses...

Input From...
Timer to Use...

Preferences...

Run...   Ctrl+R

■ **Background Color...**

Opens a dialog where you can choose a background color to use when SuperLab Pro runs an experiment. You can also define custom colors; these are remembered between sessions.

■ **Codes...**

Opens the Codes Editor dialog, explained in detail earlier in this chapter.

■ **Responses...**

Opens the Response Editor dialog, explained in detail earlier in this chapter. The Response Editor may be look different depending on which input module you choose to use.

■ **Input From...**

Lets you choose the method you would like to use to obtain responses from the subject. The list of available input modules appears in a scrolling list on the left side of the dialog box. To the right, explanatory text provides some information about the module.
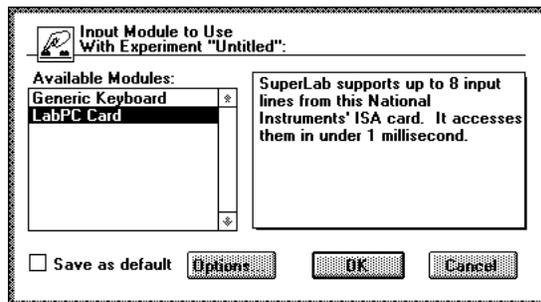
At the bottom of the dialog box, three buttons and a checkbox are provided: the familiar OK and Cancel, Options, and Save as default. The Options button is enabled or disabled automatically depending on the input module you select. Some input modules will provide a small dialog that lets you set additional

options when you click on this button.

If the "Save as default" checkbox is checked, it makes the selected input module the one SuperLab Pro will use next time you create an experiment.

For more complete information on input accuracy, see the chapter "On Timing And Input." To develop your own custom input modules, see "SuperLab SDK."

■ Timer to Use...

Lets you choose the timer you would like to use to time the responses obtained from the subject. The list of available timers appears in a scrolling list on the left side of the dialog box. To the right, explanatory text provides some information about the timer.

If the "Save as default" checkbox is checked, it makes the selected timer module the one SuperLab Pro will use next time you create an experiment.
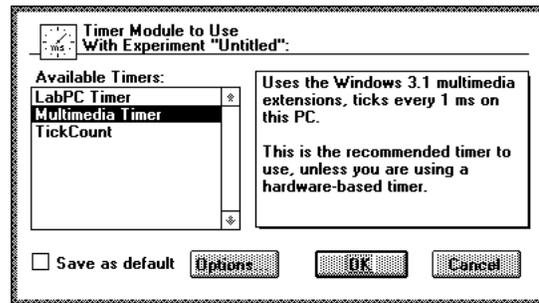
For more complete information on timing accuracy, see the chapter "On Timing And Input." To develop your own custom timer modules, see "SuperLab SDK."

■ Preferences...

Sets some memory preferences. These are important in cases where memory is not plentiful. By not setting "Keep all events in memory at all times," you can have experiments whose size becomes practically limited only by the size of your hard disk, not the size of RAM.
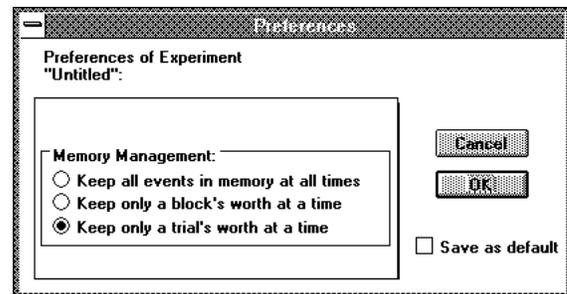
Check the "Save as default" checkbox if you want the memory mode you set to become the default for all experiments you create later.

■ Run...

Runs the experiment. You will first be presented with the dialog below. In it,

enter the subject's name. The dialog also contains two checkboxes:

≡ The "Save collected data" is an
obvious one; if unchecked,
SuperLab Pro will simply not
save any results.

≡ The second checkbox will be
disabled (grayed) if no block
was selected when you chose Run from the Experiment menu. But if you
do have one or more blocks selected, turn on this checkbox to run only the
selected blocks.
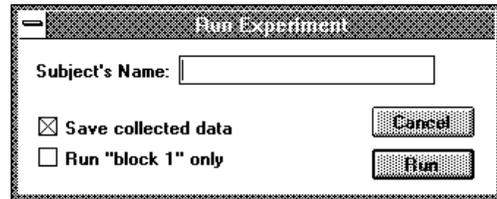
Next, if "Save collected data" is checked, you will be presented with a standard
"Save File" box where you need to specify the name of the collected data file.
Click on the OK button to proceed with the experiment.

To cancel an experiment in progress and the input is from the keyboard, press the
F1 key. To cancel an experiment and the input is from another source, hold
down the F1 key while providing that other source with an input. For example, if
input is from a Cedrus RB-400 response box, hold down the F1 key then press
any of the pushbuttons on the response box.

The Help Menu

The Help menu lets you access the online help file and other information.

■ **Contents**

Brings up the main online help window. Click on the underlined keywords to go
to a certain topic.

■ **Search for Help On...**

Brings up a dialog where you can enter the particular keyword that you are
looking for.

■ **How to Use Help**

If you are new to using Windows, chose this menu item for help on how to use
the online help system.

■ **About SuperLab Pro**

Displays the current version of SuperLab Pro and other information.

Chapter 6 - More On SuperLab Pro

This chapter discusses additional topics of interest. Some are intended for the curious or technically oriented users. Others have a wider intended audience.

Description of the Collected Results File

SuperLab Pro records all the responses provided by the subjects, whether correct or not. These are saved in a tab-delimited text-only file.

The above snapshot of the results file has been formatted for presentation's sake; the results file you obtain will be plain text.

The first field is the trial name. The second field is the trial number (order). The reason for this redundancy is because a trial number is easier to process with statistical software than a name.

The third field is the event number, followed by the subject's response. In the snapshot above, responses are either blank (space bar) or the character B.

The fifth field contains an error code. SuperLab Pro generates an NR for no response, C for correct, an E for error, or an SC for self-correct, meaning the subject responded previously with a wrong answer then responded with the correct one. The error code is followed by the reaction time, in milliseconds.

A varying number of fields follow the reaction time; these are the code values attached to the trial. The number of fields depend on how many codes you have

defined.

Frequently Asked Questions

This section provides some answers to frequently asked questions by SuperLab Pro users.

Q. *My visual stimulus takes too long to display. Anything I can do about it?*

A.   Use offscreen buffering whenever possible.

Q. *Occasionally, when I want to quit SuperLab Pro, it asks me if I want to save the changes, even though I do not recall making any. How come?*

A.   A number of things could cause SuperLab Pro to remind you about saving the changes. Some are features, others are not.

For example, when loading the experiment and the data files associated with it, there are times when the program cannot locate a particular data file and it prompts you for its location. After you have located it, SuperLab Pro records the new location. This is considered a change that needs to be saved, otherwise you will be asked to locate the file every time you open the experiment.

Also, anytime you are presented with a dialog box and click on OK instead of the Cancel button, SuperLab Pro may record it as a change even if you didn't change anything.

Q. *When I open an experiment, SuperLab Pro sometimes says it cannot locate one or more of the stimuli data files (pictures, sound, etc.). Why?*

A.   This could be due to the fact that you moved the data file from a folder or directory to another, or from one disk to another. Once you have located the files, SuperLab Pro will record the new location and will not bother you the next time.

Q. *If two or more visual stimuli use the same picture file, does SuperLab Pro keep multiple copies of the picture in memory?*

A.   No, no matter how many stimuli use a picture file, SuperLab Pro keeps only one copy in memory. The same holds true for auditory files.

This section is of interest to those of you using Microsoft Excel to edit SuperLab Pro experiments directly.

Here's an experiment fragment we can use as an example in the following discussion:

```
#Picture-File

F-1 test L  Aaker.bmp      1158     0   0    265 ...

F-1 test R  Abraham.bmp    1158     0   0    0   ...

F-3  acq    Andrews.bmp    1158     0   0    0   ...

F-4 test L  Amira.bmp      1158     0   0    0   ...
```

The first parameter of a #Picture-File keyword is the event name, followed by the stimulus' file name, path ID, and so forth.

As originally written, SuperLab Pro would read its experiments as is. One day, one of our beta testers edited the experiment above using a different version of Microsoft Excel and saved the changes. This is how Excel saved it:

```
#Picture-File

F-1 test L  "Aaker.bmp"    1158     0   0    265 ...

F-1 test R  "Abraham.bmp"  1158     0   0    0   ...

F-3  acq    "Andrews.bmp"  1158     0   0    0   ...

F-4 test L  "Amira.bmp"    1158     0   0    0   ...
```

Notice the addition of double quotes on the second field. As it turns out, if a cell in Excel contains a comma or a double quote, then the entire cell gets double-quoted when saved to disk. Here are some examples:

```
My Name        gets saved as    My Name

Aaker,N        gets saved as    "Aaker,N"

This "is" it   gets saved as    "This ""is"" it"

"Test!"        gets saved as    """Test!"""
```

To work around this "feature," we modified SuperLab Pro to handle these quotes. This imposes a restriction on the way you name your events, trials, etc.: the first letter may not be a double quote.

SuperLab Pro supports the National Instruments' LabPC, PC-LPM-16, and PC-TIO-10 i/o cards, and the Computer Boards' CIO-DIO24 card. These are ISA cards with 24 digital i/o lines that can be used for either input or output. These lines are separated into 3 ports, with 8 lines each. SuperLab Pro uses Port A for input.
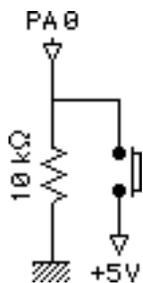
If you decide to use one of these cards, Cedrus offers a four-button response box. But you may still want or need to build your own box. Depending on the card model, you need to use a 50-pin flat ribbon cable or a DB-37 connector between your box and the card. The box may contain up to 8 switches, depending on your experiment's needs. For each switch, you need a push-button and a 10 kiloohms (k½) pull-down resistor, wired as illustrated in the diagram on the left.

For more information and diagrams, refer to your National Instruments user manual.

For the CIO-DIO24 i/o card, use a similar diagram with a lower resistor value, and connect all unused pins to ground.

License Agreement

Nearly every software license sold is governed by a license agreement, sometimes called an End User License Agreement (EULA). Here is the EULA that governs the use of SuperLab Pro, first in plain English.

In Plain English

It's really simple:

No two persons may use SuperLab Pro at any one time.

Whenever in doubt, refer to item 1 above.

Our EULA offers more flexibility than other vendors', many of whom insist that the software may be installed on one machine only.

Some Frequently Asked Questions

Can I develop an experiment on one computer and run it on others?
No. You can run SuperLab Pro to develop and collect data on only a single computer. If you only one to collect data (but not develop and experiment or modify it) on other computers, Cedrus offers inexpensive "run only" licenses.

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