

MEDLAB8™

BASIC SCHEDULES FOR MED-PC®

SOF-700LA-1

USER'S MANUAL

DOC-020

Rev. 1.7

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notes

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CHAPTER 1 | INTRODUCTION

MedLab8 is a set of eight MedState Notation™ (MSN) procedures first written for student lab stations with minimum configurations. Each procedure is contained in a separate text file with extension .MPC. These files provide complete ready to run procedures as well as a valuable supplement to the MedState Notation programming manual supplied with MED-PC® IV. MSN is a powerful developmental language that allows for much latitude in accomplishing any given task. The files in MedLab8 illustrate just one way to create some basic schedules of reinforcement, to document and collect simple data, to create an array for SoftCR™, the Soft Cumulative Recorder, and to time a session.

Before the MedLab8 procedures may be run, it is necessary to run the MED-PC IV Hardware Configuration Utility to assign the proper Port and Bit values for each Input and Output present. It may also be necessary to edit the Input or Output constants in the procedures. Files may then be translated and compiled with the Trans IV program. Detailed instructions are provided in the next chapter. It is recommended that a backup copy of the procedure files be made before modifying them to meet specific research or demonstration needs.

The sooner one becomes familiar with editing the MSN text files, as well as translating and compiling the files with Trans IV, the more one may appreciate the tremendous advantages of MED-PC IV. Additional information may be found in the MedState Notation Programming Manual. In particular, sections on terminology, typing conventions, and general definitions, are recommended before editing the .MPC files.

Software Description

The MedLab8 distribution contains eight MSN files as listed:

- MedLab8 Fixed Ratio.mpc: Default value of FR1 or CRF.
- MedLab8 Fixed Interval.mpc: Default value of FI 1 second.
- MedLab8 Variable Ratio.mpc: Default value of VR5 (Mean of 5 with a range from 1 to 20 responses).
- MedLab8 Variable Interval.mpc: Default value of VI10 (Mean of 10 seconds and a range from 0.25 to 40 seconds).
- MedLab8 Random Ratio.mpc: Default value of RR5 (Mean probability of 20% chance of reinforcement on each response).
- MedLab8 Random Interval.mpc: Default value of RI10/Probability 20 (Mean interval of 10 seconds, i.e., a "timer" has a 20% chance of timing out every 2 seconds).
- MedLab8 Discrimination.mpc: GO/NO-GO The default procedure switches S+ and S- every 30 seconds for the duration of the procedure.
- MedLab8 Chain.mpc: Two part chain with the first FR = 1 with the Left Lever being the correct lever. The second FR = 5 and the right lever is correct.

Running the Hardware Configuration Utility

The Hardware Configuration Utility is an executable program supplied with MED-PC IV that is used to configure each chamber accessory to specific interface modules. A wiring chart supplied with chambers assembled by MED Associates, Inc. clearly identifies each I/O (Input/Output) by function and provides the proper Port and Bit values for each chamber. If setting up a system for the first time it is necessary to run this program before the MedLab8 procedures may be used with the interface and test chambers¹. Refer to the **MED-PC IV Users Manual** for additional information on Ports, Bits, and the running of Hardware Configuration Utility. Systems using the SmartCtrl™ Interface Modules require that the number of Boxes and the model number of the SmartCtrl cards being used is identified.

Printing the MedLab8 (*.MPC) Files

The MSN files contain useful information on the function of each procedure. These files may be loaded into the Trans IV, Notepad, or any other text editor and printed. For example, to open and print the file MedLab8 Fixed Ratio.mpc with Trans IV, go to **File | Open** select the file MedLab8 Fixed Ratio.mpc and then select **File | Print**. In order to gain insight on how the code works, pay particular attention to the text that is preceded by a back slash (\). These are Comments that are placed throughout the code to give the user information about the protocol.

CHAPTER 2 | EDITING PROCEDURES

For users with a SmartCtrl interface system, the MedLab8 procedures should be ready to translate and compile. In some instances, however, it will be necessary to make some configuration or procedural changes to accommodate various hardware packages. These changes are quickly and easily made and will help demonstrate the flexibility that MED-PC IV permits for running in diverse environments with an infinite number of programming variations not found in any other system.

Modifying MedLab8 Procedures

A basic understanding of the MedState Notation (MSN) language is necessary to edit the procedures at the code level. It is recommended that the user read the MedState Notation Programming Manual to gain this insight. It is not necessary to have this knowledge, however, to parse, compile, and run MedLab8 Procedures or to make simple adjustments to the predefined constants (if necessary).

The procedures of MedLab8 were written using the following constants to define each Input and Output:

```
\ Standard Input Configuration
^LeftLever  = 1
^RightLever = 2

\ Standard Output Configuration
^Pellet     = 3
^Dipper     = 3 \ If both Pellet and Dipper are ordered
              \ It will be necessary to change one of these
^LeftLight  = 4
^RightLight = 5
^HouseLight = 7
^Pump       = 8
```

NOTE: The procedures, as written, will work with either Pellet or Liquid Drop Dispensers without modification. When using a Liquid Drop Dispenser, the word Pellet may be replaced with the word Liquid for clarification. Although this is easily done with the search and replace feature of most editors, it is not necessary for proper operation.

To demonstrate the use of the Trans IV Editor, the following illustration will change MedLab8 Fixed Ratio.mpc for a system in which the Pellet dispenser is wired to Output 4 instead of Output 3.

In Windows, open the Trans IV software:

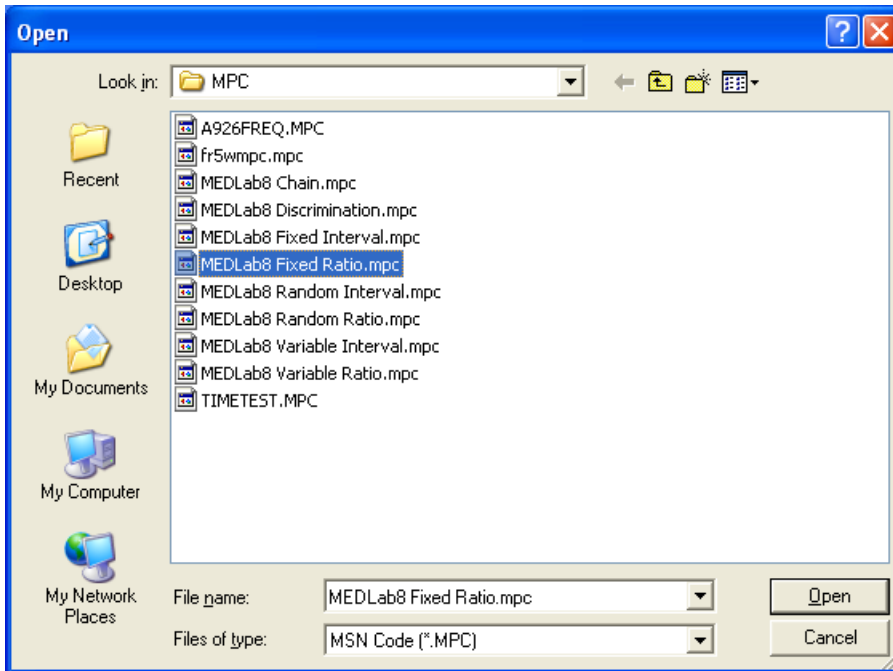
Figure 2.1 – Open Trans IV



To open a file, go to **File | Open**. The default directory is C:\MED-PC IV\MPC and if the MedLab8 files were properly installed, all eight of the procedures should be showing on the screen. If not, refer back to "Installing the Software" section in Chapter 1.

Open the file MedLab8 Fixed Ratio.mpc by double clicking on it in the "Open" pop-up window:

Figure 2.2 – Open the file MedLab8 Fixed Ratio.mpc



The open file should now appear on the screen.

Once the file is loaded, use the Down Arrow key to move the cursor down to approximately Line 18 of the procedure. The Line/Character counter is in the lower right hand corner of the editor screen. The line should read:

^Pellet = 3

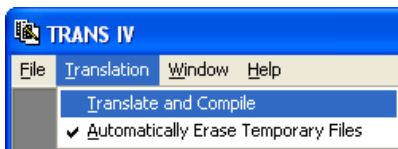
Use the Right Arrow key, the End Key, or a Mouse to place the cursor over the three. Delete the "3" and change it to a "4". To save the changed file, go to **File | Save**. The file has been saved.

Translating and Compiling the Modified File

Before closing Trans IV a few additional steps are required to incorporate the above change into the available procedure list in MED-PC IV:

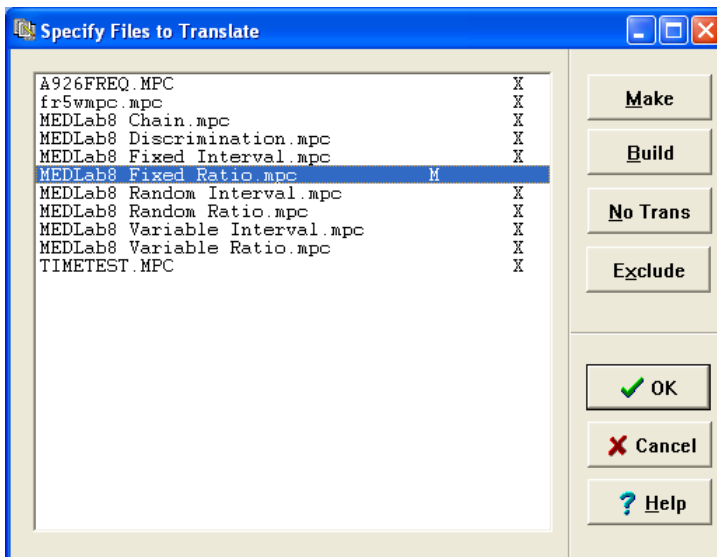
1. On the menu bar, select **Translation | Translate and Compile**:

Figure 2.3 – Translate and Compile Menu Option



2. Highlight the file name **MedLab8 Fixed Ratio.mpc** and click **Make**. Note: The other procedures may be excluded by highlighting them and clicking **Exclude**.
3. There should now be a letter "M" a tab space or two away from the file name.
4. Click **OK** and the procedure should automatically Translate (Parse) and Compile.
5. When it is finished, close Trans IV by selecting to **File | Exit**.

Figure 2.4 – Compiling the MedLab8 Fixed Ratio Procedure



CHAPTER 3 | MED-PC IV RUNTIME SYSTEM

Introduction

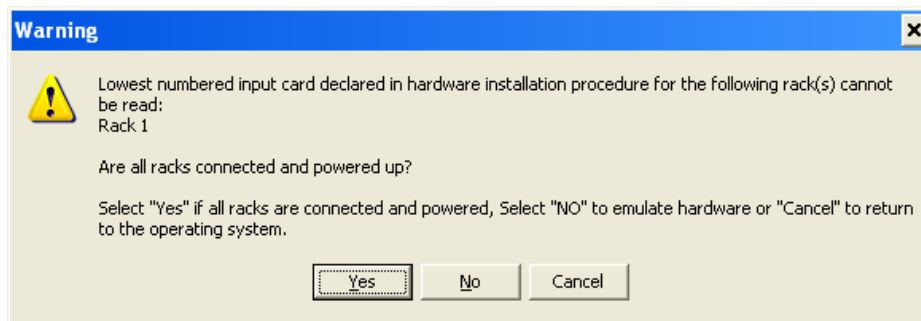
Once the procedures have been properly compiled, simply selecting the proper procedure in the MED-PC IV Loading Wizard or the Open Experimental Session Window allows the user to run them.

Note: This chapter does not cover all runtime features. For more information see Chapter 4 of the MED-PC IV User's manual.

Interface Test Screen

When MED-PC IV starts, an attempt is made to determine whether an interface is attached. If MED-PC IV starts directly into the Loading Wizard or its Runtime Screen, it has detected that the hardware is configured properly and turned on. If these conditions are not met, MED-PC IV will give the following warning message:

Figure 3.1 – MED-PC IV Warning Message



1. **Interface Present:** In the event that an interface is present and MED-PC IV reports that it is not, simply turn the power on and select "Yes."
2. **Hardware Emulation:** Select "No" if the hardware is not present or is simply not required, for example, when testing procedure changes with keyboard simulated responses. The Hardware Emulation mode is a viable mechanism for doing all but final testing of software and is useful for classroom teaching exercises. During Hardware Emulation sessions, the interface hardware will be totally ignored, even if present, but responses may be simulated via keyboard input commands. This will be discussed under "Responses (#R)" later in this manual.
3. **Exit to Windows:** If necessary, MED-PC IV may be terminated at this point by selecting "Cancel."

The MED-PC IV Runtime Screen

In most instances MED-PC IV proceeds directly to the Loading Wizard or the Runtime Screen (shown below). This is the screen present when running any MED-PC IV procedure. It is divided into three main sections: 1) the SHOW area 2) status lines for boxes 1-16, and 3) the row of

Running the FR Procedure

This section deals with "Loading" and "Running" a procedure within the runtime system. For the purposes of this example, the MedLab8 Fixed Ratio.mpc procedure will be used and just a few of the features of the runtime system demonstrated.

Opening an Experimental Session

Opening an experimental session refers to assigning an experimental procedure to a Box and causing the Box to begin executing the procedure. When MED-PC IV is first loaded, all Boxes are "closed," or "unloaded," which is to say that there are no MSN procedures running within any of the Boxes. To load a Box, select **File | Open Session**. The screen shown in Figure 3.3 will appear.

Figure 3.3 – Open Experimental Session Window

Box Identifiers

The **Subject**, **Experiment**, and **Group** numbers (also referred to as Identifiers) are arbitrary values that may be set to any character alphanumeric name. Bear in mind that these values are also used in generating data file names if the "Append data to a file with name based on experiment, group and subject identifiers" or "Create a new file for every session, named according to date, time and subject" file naming option was selected during installation.

Procedure

Procedure refers to the MSN procedure (*.MPC file) that will be run. Any MSN procedure that was compiled by Trans IV may be loaded into any compatible Box defined when the Hardware Configuration Utility was run. If loaded and parsed (compiled) properly, all eight MedLab8 procedures should be listed under the "pull-down" menu. To confirm this, click the arrow and see if all eight procedures are listed.

Boxes to Load

Check the Box number(s) to load. By default, the first available box is automatically offered.

After completing the screen, clicking **OK** loads the box and causes a status line to appear for the Box in the upper left hand corner of the screen. After loading Box 1 with "MedLab8 Fixed Ratio," repeat the process to load Box 2 with "MedLab8 Fixed Ratio." A Box may be loaded even while other Boxes are running without affecting those Boxes. Two or more Boxes may be loaded at the same time just by selecting multiple check boxes. As soon as a Box is loaded, the procedure is "started" although nothing may happen. This is the case with "MedLab8 Fixed Ratio" since the first command in this procedure is #START. The use of #START is covered shortly.

Changing Variables

Figure 3.4 – Named Variables Screen

Variable Name	Value
Correct Lever (Left=1 Right=2)	1.000
Reward (Pellet=1 Dipper=2 Drug=3)	1.000
Reward Time (sec)	0.050
Time Out Following Reward	0.000
Session Time (Min)	60.000
Fixed Ratio Value	1.000
Maximum Reinforcers	50.000
SoftCR Data Array (Yes=1 No=0)	1.000

Display Data from Box: 1 2 3 4

Additional Boxes to Update: 1 2 3 4

Buttons:

The "Change Variables" screen may be brought up by selecting **Configure | Changing Variables** (Figure 3.4). Changing the value of any appropriate field changes only the Box whose data are displayed. All Boxes may be changed by clicking **Select All**, or only select Boxes may be changed by clicking the appropriate number(s) in the **Additional Boxes to Update** section of the window. Clicking on the **Named Vars** button will display a list of variables that have been given a more descriptive name by the use of the Var_Alias command in the MSN procedure. The user is also given the chance to change these named variables when a program is loaded using the Loading Wizard.

Changing the MedLab8 Fixed Ratio FR Value

To modify the FR variable's value, click on the **Named Vars** button. A list of two variables will be displayed. One of the rows will be labeled "Fixed Ratio" and its default value will be 1. To change this to an FR-5, replace 1 with 5 and click **Issue**.

NOTE: If FR-5 will be run for several days, it may be simpler to modify the procedure, save it under its own name, and add it to the procedure list. Follow the same procedure previously described for changing a constant value or the value for the reinforcement timer. The only statements to change are contained in State 1 of State Set 1. The change to "A(FRVal)" has been made below. Compare this with the current version of MedLab8 Fixed Ratio.mpc.

```
S.S.1,  
S1,  
0.001": SET A(^CorLever) = 1, A(^Reward) = 1, A(^RewTime) = 0.05;  
        SET A(^TimeOut) = 0, A(^SessTime) = 60, A(^FRVal) = 1;  
        SET A(^MaxReinf) = 50, A(^SoftCR) = 1;
```

Changing the MedLab8 Fixed Ratio Session Time

Changing the Session Time is done in a similar manner by changing the value of the row labeled "Session Time (Min)" on the Named Vars screen to the number of minutes desired for the Session Time. For example, to set a 30-minute Session Time, replace the value 60 with 30 and then click **Issue**.

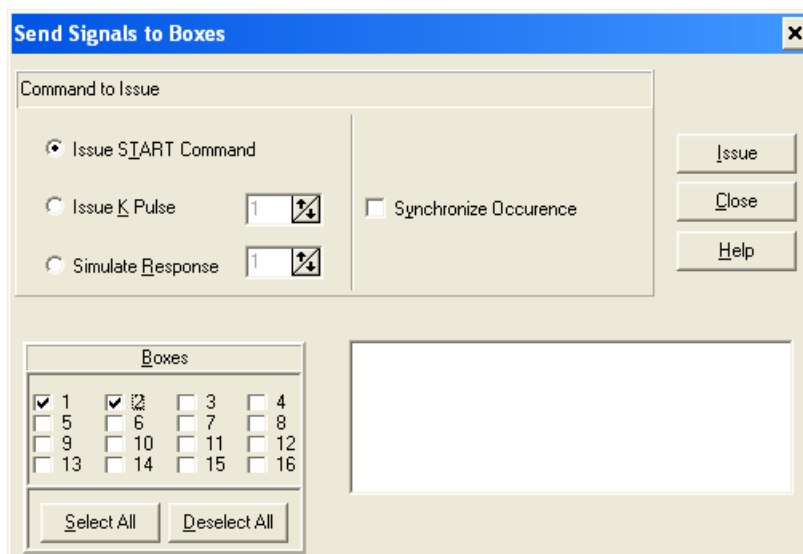
To close the Named Variables Window, click **Close**.

Issuing START

To actually start the MedLab8 Fixed Ratio procedure, a command must be issued. This feature allows the user to load the program, change Ratios or Session Times, and place the animal in the test chamber before actually activating the procedure.

The #START signal may be issued to Boxes by selecting **Configure | Signals**. The screen shown in Figure 3.5 will appear.

Figure 3.5 – Send Signals to Boxes Window



The "Issue START Command" option is already highlighted, so simply select the check boxes next to the Boxes to be run. Once all necessary buttons are selected (represented by check marks), press the **ISSUE** button. The program is now running.

SHOW Data From a Box

As soon as MedLab8 Fixed Ratio is "started" in any one of the loaded boxes, a SHOW display will appear at the bottom of the screen with Labeled counters for each lever, a reinforcement counter, the FR ratio in effect, and the elapsed session time, in decimal minutes.

The SHOW Command

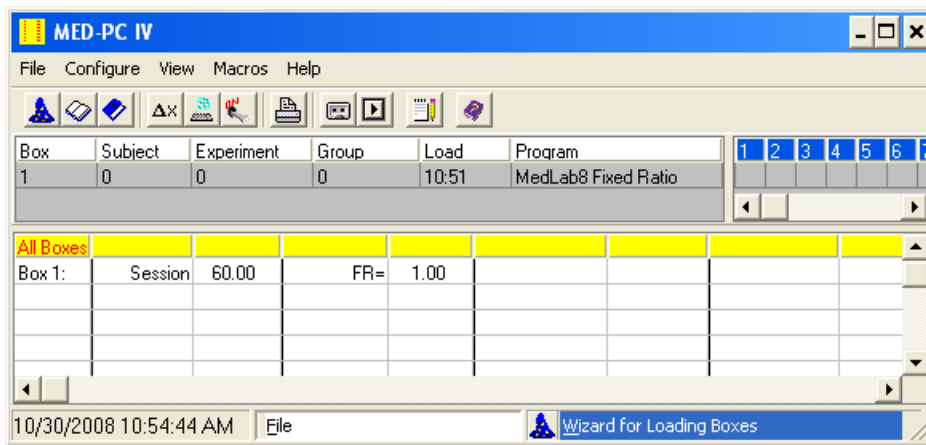
The SHOW command is covered in the MedState Notation Programming Manual. It is the mechanism whereby MSN programs may place data on the screen. Each box may place the values of up to 200 variables or array elements on the screen, along with descriptive labels for each datum.

Miscellaneous

SHOW commands are not displayed in real time. When a box issues a SHOW command, the data values are retained, but the data is not actually displayed until the runtime system has time to update the screen. The values eventually shown on the screen reflect the values of their respective variables at the moment that their respective SHOW commands were issued. In practice, the SHOW screen is usually updated within a small fraction of a second after any changes are made by active Boxes. Most users would probably not even notice that updates are not in "real time" except in the case of displaying running response totals for rapidly responding subjects, in which case the response total shown on the screen appears to discontinuously count up. For example, response totals might display as 1,3,7,8, etc. instead of 1,2,3,4,5,6,7,8, etc.

The SHOW Display

Figure 3.6 – The SHOW Display



Looking at Figure 3.6, we are interested with the text that says "All Boxes" in red on the left hand side of the screen. This is the way in which the display of data may be changed. By default, the "All Boxes" option will be selected. This provides the user with a summary of data from every Box loaded. It displays only "SHOW" positions 1-5.

If we are interested in one Box in particular, clicking on that Box's name along the left hand side will display all of the SHOW positions for that one Box. Up to 200 SHOW positions may be displayed at one time. Double clicking on the red text will once again display all Boxes.

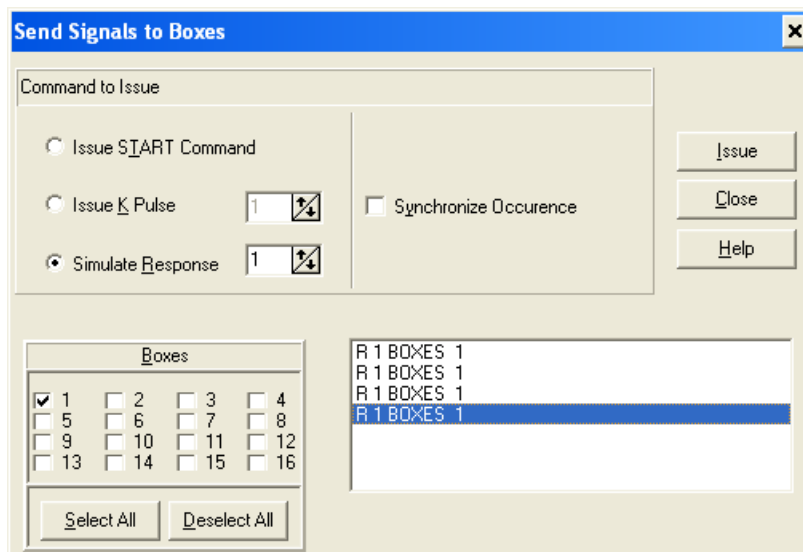
Right clicking on the red text that says "All Boxes" and selecting FLIP will cycle the display through each Box one at a time and display all 200 SHOW positions from each Box for 5 seconds at a time. That is, the SHOW output from the first Box is displayed for five seconds, followed by the output from Box 2, etc. Before cycling back to the first Box, however, a summary of the data (as if ALL was selected) is displayed.

It is worth noting that you may switch between these modes while the experiments are being run without affecting the data collection.

Issuing a Response (#R)

Responses (#R Inputs) may be simulated from the keyboard with or without the interface and test chambers. Selecting **Configure | Signals** on the menu bar accesses this feature.

Figure 3.7 – Issuing a Response



In order to issue the Response, first select the "Simulate Response" option, select to which Box or Boxes the command should go to, then select which Input the command should come from (e.g., if the Left Lever should be pushed, select 1, if the Right Lever should be pushed, select 2) followed by clicking on the Issue button. Please note if 5 Responses are desired, click the Issue button 5 times.

In the MedLab8 Fixed Ratio procedure several things happen when a Response #1 occurs. First, the Lever1 count increments by one. Second, if the default FR value, FR-1, has not been changed a number "3" flashes at the end of the Box status line for 50 ms in the upper right hand corner. This indicates that Output 3 has been turned on for 50 ms². If an interface and chamber are connected, the Pellet or Liquid Drop Dispenser should have been activated. Issuing a Response #2 simply increments the Lever2 counter.

² Remember, because these displays are not in real time as discussed previously, short output intervals such as this may not display consistently. The only way to verify their occurrence is with the Interface and Output device connected.

Ending a Session

As it stands, a Session Time has been entered for MedLab8 Fixed Ratio through the "A(^SessionTime)" variable and the procedure will "STOPABORTFLUSH" automatically when the Session Time reaches the value of "A(^SessionTime)" (the default is 60 minutes). A procedure that is running may also be terminated from the menu in either of three ways.

The **File | Close Session** menu option brings up the following window:

Figure 3.8 – Close Session Window – STOPABORTFLUSH

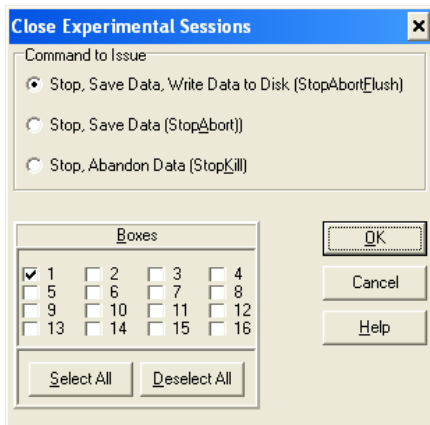
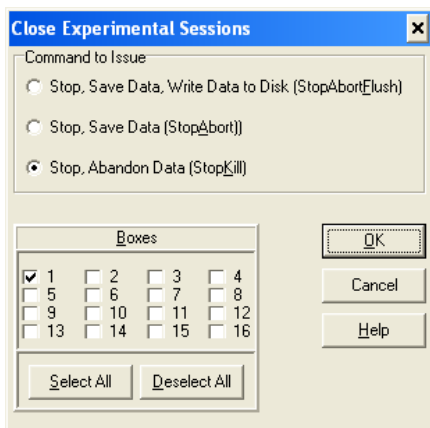


Figure 3.9 – Close Session Window – STOPKILL

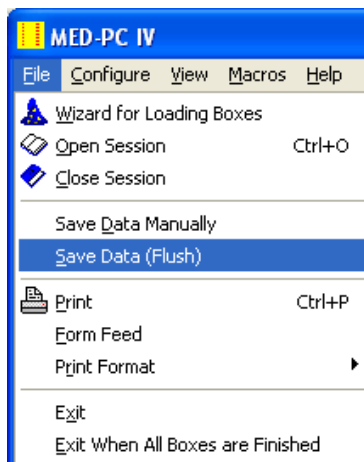


In order to issue the stop command, select the appropriate manner in which to stop the session and the Box or Boxes to stop. Once this is done, select "OK."

Saving Data

Two menu selections are provided for writing data to disk following the termination of a procedure (terminated either from the menu or from within the procedure using the MSN Command STOPABORT). Both options are located underneath the "File" option of the Menu Bar. The first option, "Save Data Manually," allows the operator to monitor and intervene in data writing operations. In contrast, "Save Data (Flush)" automatically transfers all data to disk without requiring further intervention. The "Save Data (Flush)" selection is identical to an MSN transition to STOPABORTFLUSH (the default setting in MedLab8 programs). Data may be written to disk while boxes are running without in any way interfering with the processing of events in those boxes. See STOPABORT, STOPABORTFLUSH, and FLUSH in the MED-PC IV Programmer's Manual for more information.

Figure 3.10 – Saving Data Menu Options



Save Data (Flush)

Regardless of the file naming and internal file format options selected during installation, the process whereby data is dumped to disk is similar. The simplest way to transfer data to disk is with the Flush option. Once this command is invoked, all data is automatically written to the appropriate disk, directory and file name(s) without further input from the operator.

The "Save Data (Flush)" option is recommended for most users and is the simplest and safest way to transfer data to the hard disk in most situations. Generally speaking, this command is preferable if all data is to be written to a single drive and directory. If a situation requires frequent swapping of disks, or if data is destined for different disks and is likely to be written to disk in close succession, then "Save Data (Flush)" option will probably not be suitable.

In the event that an error occurs either during a "Save Data (Flush)" option from the menu or from a FLUSH command issued within an MSN program, then the rest of the data dumping operation will proceed as though "Save Data Manually" was requested. This is done so that error messages may be conveyed to the operator and so that the operator may indicate when the source of the error has been corrected. Error conditions are normally reported by the appearance of a message box on the screen along with a description of the error.

Note that issuing a FLUSH or STOPABORTFLUSH from within an MSN program causes all data in the dumping queue to be written to disk, not just the data associated with the box that initiated the request.

Save Data Manually

This option is primarily intended for special situations in which a high degree of user control over the transfer process is required or when a unique file name should be assigned to each file. This option may also be used to correct disk errors, dump with ID Verification, dump multiple copies of data to different floppy disks, etc. When this command is invoked, a panel will appear with an input field containing the drive, directory and default file name. The file name may be edited, if desired to any legal file name with any valid drive and directory.

Printing Data

As a general rule, it is not recommended that to print from the file menu primarily because all MedLab8 programs are, by default, ended with a "STOPABORTFLUSH" command. Since this command automatically saves the data and then wipes the resident memory clean, there is nothing to print once the program has stopped running. To print out the raw data there are two options. The first is to print out the file generated after the " STOPABORTFLUSH" command saves the data. This file may be opened with any text editor (e.g., Trans IV or Notepad) or word processor (e.g., Word or Word Perfect). The other option is to edit the code to generate a print out of the data before flushing (saving) it. For assistance on this, please consult the MedState Notation programming manual.

CHAPTER 4 | THE MEDLAB8 PROCEDURES

Introduction

As stated earlier, a working knowledge of MedState Notation is not needed to run these programs. In order to edit beyond the simple tasks laid out in Chapter 2, the MedState Notation Manual should be read in its entirety. If all that is desired is a better understanding of the commands (e.g., #R, #Z, #START, IF, ADD, SHOW, SET) we suggest using the index to lookup the function of each command.

This chapter describes the function of the eight programs that make up MedLab8. Each program name will be listed, followed by a brief description of what it was written to do as well as the variables that may be easily changed via the Change Variables Window or displayed on the screen or in data files. In addition, each program's text file (the *.mpc files) are full of comments that explain what each section of the program does and in many cases why they are done the way they are. This is a very powerful tool for the user that wants to change the programs down the line or use these programs as a starting point for the development of personal programs.

MedLab8 Fixed Ratio.mpc

Fixed Ratio is a schedule of reinforcement in which a response is reinforced only after a specified number of responses. This schedule produces a high, steady rate of responding with only a brief pause after the delivery of the reinforcer.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Fixed Ratio Value		Default = 1
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

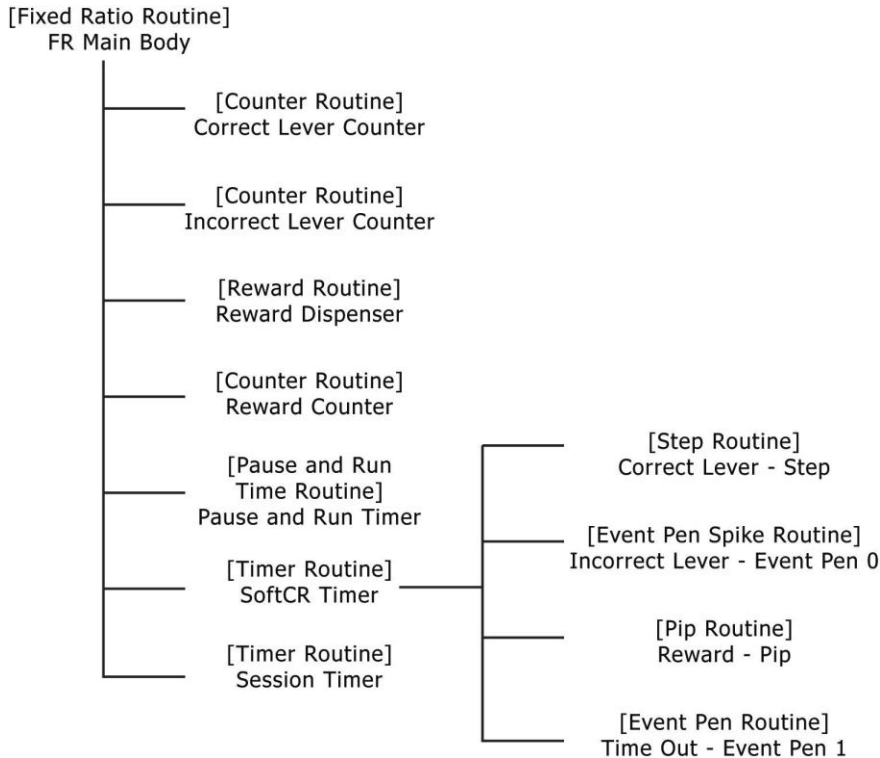
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.1 – Fixed Ratio Functional Diagram



MedLab8 Fixed Interval.mpc

Fixed interval is a schedule of reinforcement in which the first response is rewarded only after a specified amount of time has elapsed. This schedule causes high amounts of responding near the end of the interval, but much slower responding immediately after the delivery of the reinforcer.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Fixed Interval Value (sec)		Default = 1 second
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

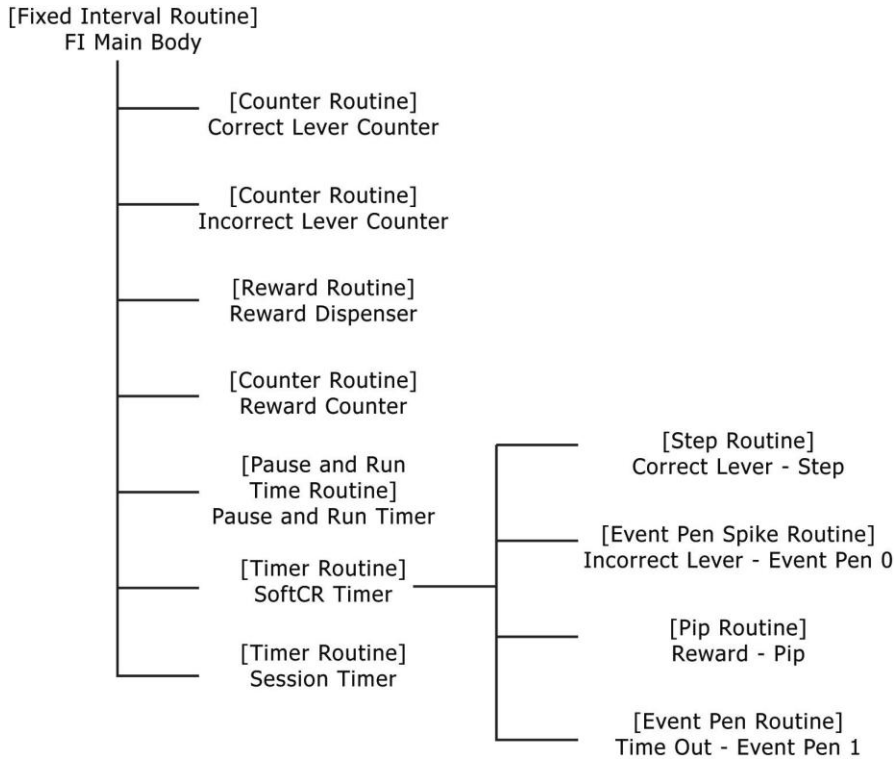
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.2 – Fixed Interval Functional Diagram



MedLab8 Variable Ratio.mpc

Variable Ratio is a schedule of reinforcement in which a response is reinforced after an unpredictable number of responses. This schedule creates a high steady rate of responding. Gambling and lottery games are good examples of a reward based on a variable ratio schedule.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Mean Variable Ratio		Default = 5
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

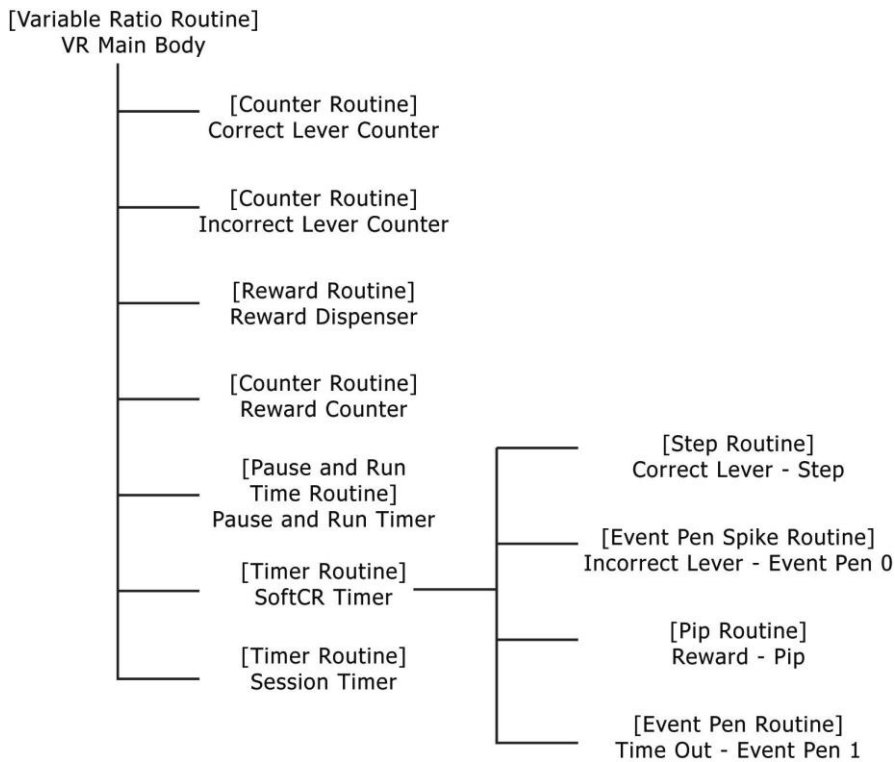
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.3 – Variable Ratio Functional Diagram



MedLab8 Variable Interval.mpc

Variable Interval is a schedule of reinforcement in which a response is rewarded after an unpredictable amount of time has passed. This schedule produces a slow, steady rate of response.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Mean Variable Interval (sec)		Default = 10 seconds
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

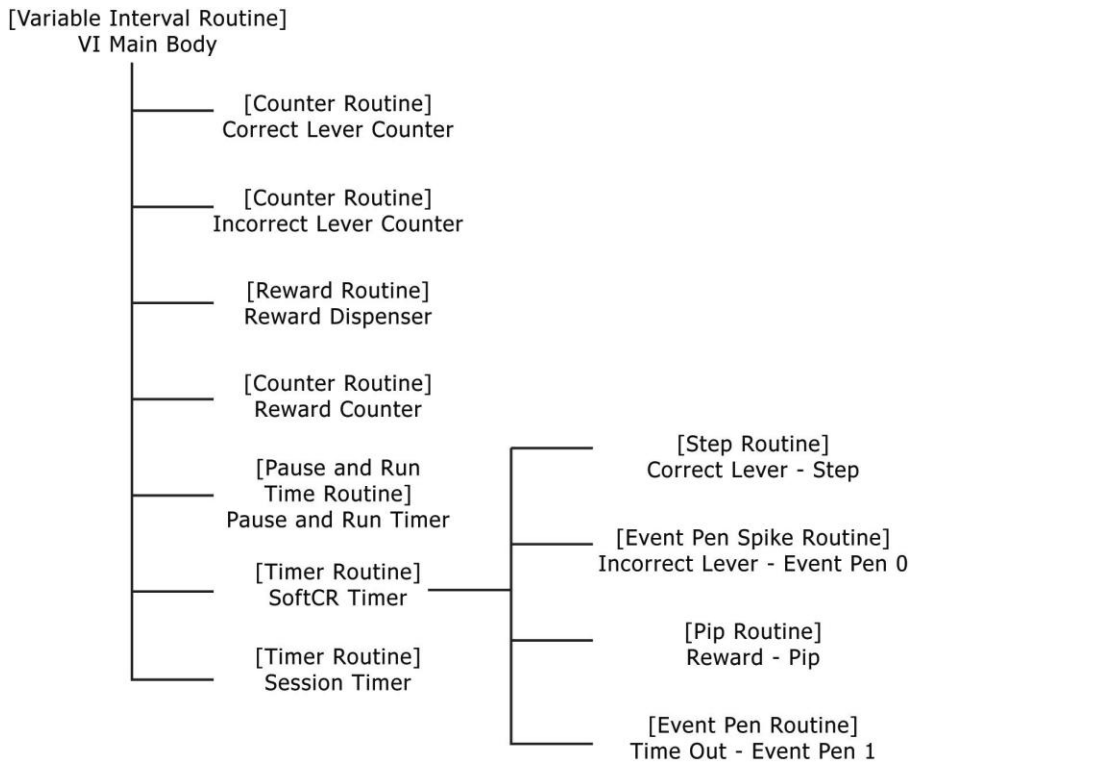
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.4 – Variable Interval Functional Diagram



MedLab8 Random Ratio.mpc

Random Ratio is a schedule of reinforcement in which the ratio specifies the probability with which a response will be reinforced. For example, in RR 5 that probability is .20 (1/5) and is independent of the number of responses emitted since the last reinforcer.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Probability Value		Default = 5*
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

* Mean Probability = 1 / 5 = 0.20

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

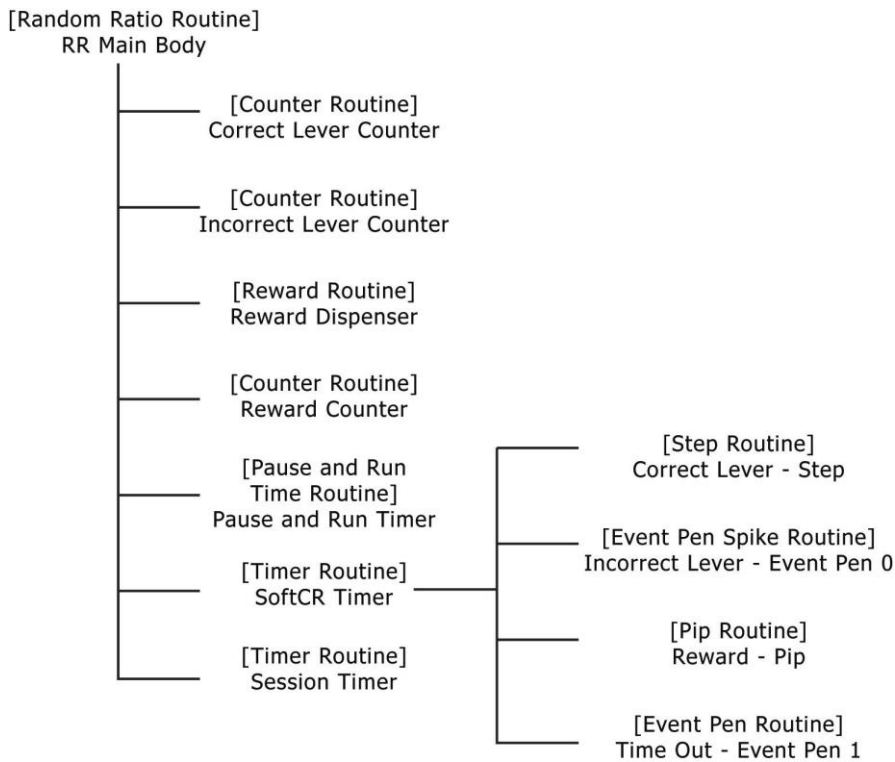
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.5 – Random Routine Functional Diagram



MedLab8 Random Interval.mpc

This schedule consists of two elements working together to create a random interval schedule. For example, RI 10 with Probability 20 means every two seconds conduct a probability test with

a one in five chance of success. For RI 10 with Probability 50, change $A(\text{Prob}) = 50$. If $A(\text{RIVal})$ remains 10 seconds, the S variable is now 5 seconds. In other words, every 5 seconds there is a one in two chance of success. The Mean for both schedules is 10 seconds, but the distribution of reinforcements is quite different.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Mean Random Interval (sec)		Default = 10 seconds
Probability Value (%)		Default = 20 percent
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Pause (sec)
- 5th Column: Run Time (sec)

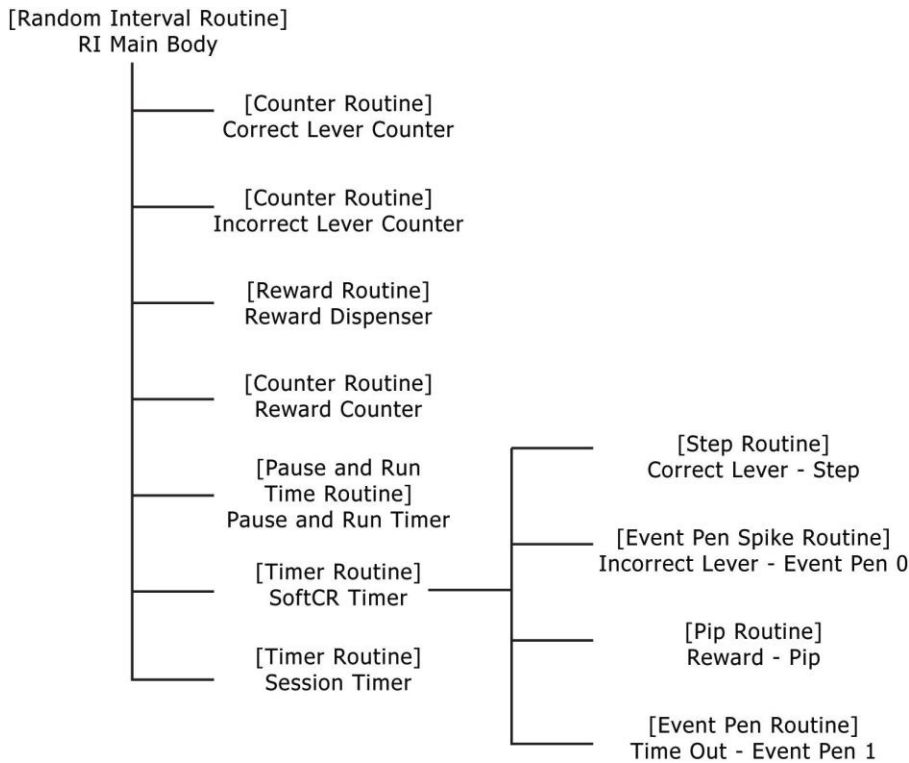
F = Total Rewards

S = Elapsed Time in Session

Pause time starts counting after a reward is given.

Run time starts counting on the first correct response.

Figure 4.6 – Random Interval Functional Diagram



MedLab8 Discrimination.mpc

This procedure is an extension of the fixed ratio procedure. It uses the stimulus light to break the Session Time into alternating periods of extinction (no light) and fixed ratio (light on). The fixed ratio defaults to an FR-1 unless the user changes the variable "A(^FRVal)". The stimulus ON/OFF times default to a value of 30 seconds unless the user changes the variable "A(^DiscrimDur)." A Session Time may also be entered by the user (variable "A(^SessionTime)") in minutes; otherwise, the default value of "A(^SessionTime)" is 60 minutes. Event marker #1 in the SoftCR array is used to mark the status of the stimulus light, up for stimulus ON and down for stimulus OFF.

Please note, all the variables may be changed and the variables A(^FRVal) and A(^DiscrimDur) follow the previously explained rule (i.e., the change will take place after the current cycle has been met). A change in A(^SessionTime), however, is immediate and must be made with care.

For example, if a procedure is started with the default A(^SessionTime) of 60 minutes and after it has run for 15 minutes, it is decided that the procedure should end in 15 minutes, A(^SessionTime) must equal the total time the procedure should run. Therefore, changing A(^SessionTime) to 15 cause the program to stop immediately, and changing A(^SessionTime) to 30 will allow the program to run for 15 more minutes before stopping.

Change Named Variables

Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
Fixed Ratio Value		Default = 1
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes
Discriminative Stimulus Duration (Sec)		Default = 30 seconds
Stimulus Light	(Left=1; Right=2)	Default = Left Light

Data Variables

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect
- Total Responses on Left Lever
- Total Responses on Right Lever

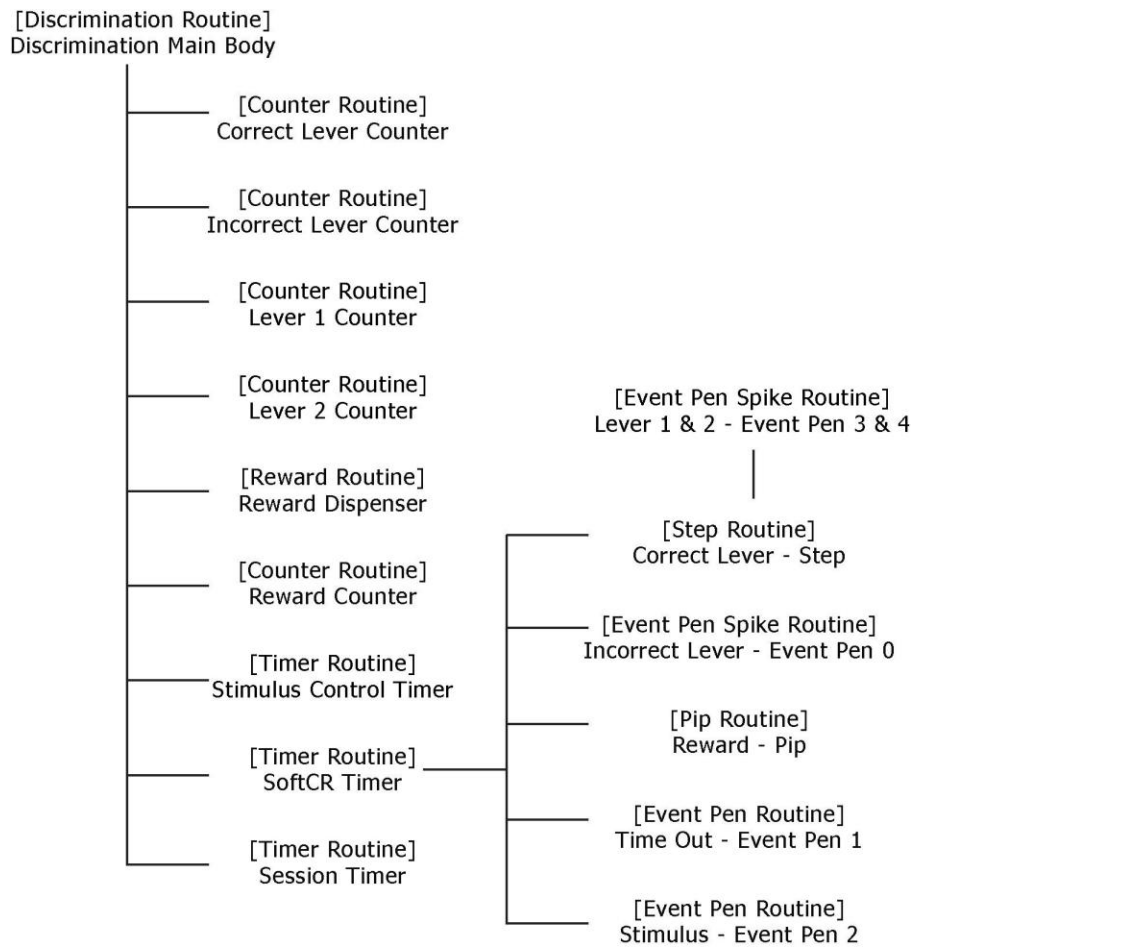
Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Not Used
- 5th Column: Not Used
- 6th Column: Response on Left Lever
- 7th Column: Response on Right Lever

F = Total Rewards

S = Elapsed Time in Session

Figure 4.7 – Discrimination Functional Diagram



MedLab8 Chain.mpc

This procedure chains two responses together and is intended be run in test chambers with two standard response levers. The procedure begins by checking which lever has been user defined as the first correct lever (A(^CorrectLev1)) and turn on the corresponding stimulus light. The animal must then press the first correct lever enough times to meet the first user defined FR (A(^FRVal1), default value FR-1).

Once the first FR has been met, the program turns off the stimulus light corresponding to the first correct lever and turns on the stimulus light corresponding to the second correct lever (A(^CorrectLev2)). The animal must now press the second correct lever enough times to meet the second user defined FR (A(^FRVal2), default value FR-5).

Once the animal has met the second FR a reinforcement is issued.

A Session Time may also be entered by the user (variable "A(^SessionTime)") in minutes; otherwise, the default value of A(^SessionTime) is 60 minutes. Changes may be made prior to or after the procedure is started.

Change Named Variables

First FR Correct Lever	(Left = 1; Right = 2)	Default = Left Lever
Second FR Correct Lever	(Left = 1; Right = 2)	Default = Right Lever
Reward	(Pellet = 1; Dipper = 2; Drug = 3)	Default = Pellet
Reward Time (sec)		Default = 0.05 seconds
Time Out Following Reward		Default = 0 seconds
Session Time (Min)		Default = 60 minutes
First Fixed Ratio Value		Default = 1
Second Fixed Ratio Value		Default = 5
Maximum Reinforcers		Default = 50
SoftCR Data Array	(Yes = 1; No = 0)	Default = Yes

Data Variables

B Array is for the first FR.

First Row in the B Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

Subsequent Rows in the B Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Not Used
- 5th Column: Not Used

D Array is for the second FR.

First Row in the D Array contains the following data:

- Total Responses
- Total Correct Response Count
- Total Incorrect Response Count
- Total % Correct
- Total % Incorrect

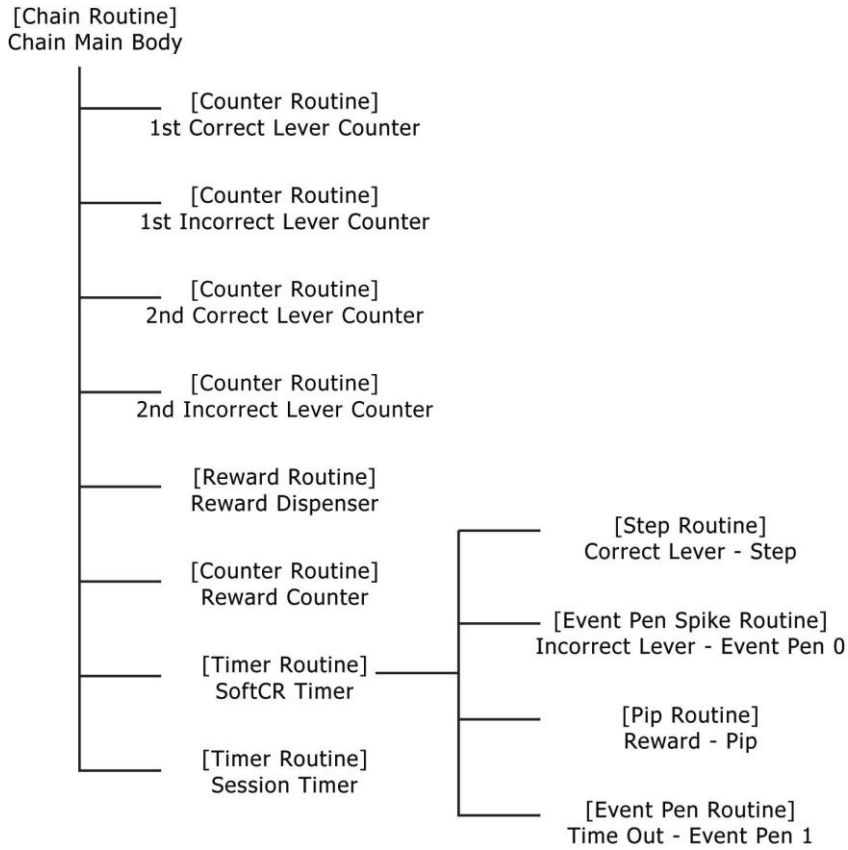
Subsequent Rows in the D Array contain the following format:

- 1st Column: Trial Number
- 2nd Column: Correct Responses
- 3rd Column: Incorrect Responses
- 4th Column: Not Used
- 5th Column: Not Used

F = Total Rewards

S = Elapsed Time in Session

Figure 4.8 – Chain Functional Diagram



Appendix A | Data File Formats

MED-PC IV can produce four format types and can place data in any array from A to Z as defined by the procedure. MedLab8 always places IRT data in the C array, uses a simple variable for the reinforcement counter, and uses both simple variables and array variables for response counters. We recommend the use of the Annotated File Format, which we will explain in great detail here. For detailed explanations of the other three file formats, please refer to the **MED-PC IV User's Manual**.

Format 1 – Annotated

The MED-PC IV "Annotated" file format creates an output file that is easy to read with, labels for each data element. It may contain data from multiple sessions, depending upon the file naming conventions used to generate the data. See the MED-PC IV manual for file naming conventions.

Annotated data files always begin with the name of the data file on line 1. Two lines are then skipped and header information begins. All simple variables are listed next followed by all array elements. These will normally be in alphabetical order unless otherwise specified in the "DISKVARs" command. In the event that more than one data set is in the data file, two lines are skipped following the last data element in the previous data set, and the "Start Date" forms the first line of the next data set. The file designation line is not repeated.

Explanations of the contents of the B Array are shown in blue below. The first row of the B Array is totals and each subsequent row contains trial data. The C Array is the SoftCR Array.

Sample Printout:

File: C:\MED-PC IV\DATA\!2007-09-11_21h03m.Subject 1

```

Start Date: 09/11/07
End Date: 09/11/07
Subject: 1
Experiment: 0
Group: 0
Box: 1
Start Time: 21:03:53
End Time: 22:06:24
MSN: MedLab8 Fixed Ratio
D:      0.000
E:      0.000
F:     15.000
G:      0.000
H:      0.000
I:     38.000
J:     80.000
K:      0.000
L:      0.000
M:      0.000
N:      0.000
O:      0.000
P:      0.000
Q:      0.000
R:      0.000
S:    3600.000
T:     980.000
U:      0.000

```

V: 0.000
 W: 0.000
 X: 0.000
 Y: 0.000
 Z: 0.000

A:
 0: 1.000 1.000 0.050 0.000 60.000
 5: 1.000 50.000 1.000 5.000 0.000

	Total Responses	Total Correct	Total Incorrect	% Correct Responses	% Incorrect Responses
B: 0:	18.000	15.000	3.000	83.333	16.667

	Correct Trial	Incorrect Responses	Pause Responses	Run Time (sec)	(sec)
5:	1.000	1.000	0.000	0.000	0.000
10:	2.000	1.000	0.000	126.000	0.000
15:	3.000	1.000	0.000	2092.000	0.000
20:	4.000	1.000	0.000	34.000	0.000
25:	5.000	1.000	0.000	1.000	0.000
30:	6.000	1.000	0.000	16.000	0.000
35:	7.000	1.000	0.000	9.000	0.000
40:	8.000	1.000	0.000	6.000	0.000
45:	9.000	1.000	0.000	9.000	0.000
50:	10.000	1.000	0.000	48.000	0.000
55:	11.000	1.000	0.000	8.000	0.000
60:	12.000	1.000	0.000	6.000	0.000
65:	13.000	1.000	0.000	24.000	0.000
70:	14.000	1.000	0.000	6.000	0.000
75:	15.000	1.000	0.000	44.000	0.000
80:	16.000	0.000	3.000	260.000	0.000

C: 0:	0.500	9072.100	0.200	1269.100	0.200
5:	20924.100	0.200	342.100	0.200	14.100
10:	0.200	162.100	0.200	99.100	0.200
15:	68.100	0.200	99.100	0.200	481.100
20:	0.200	80.100	0.200	67.100	0.200
25:	247.100	0.200	61.100	0.200	444.100
30:	0.200	1556.600	0.500	33.600	0.500
35:	2.600	0.500	980.310		

Absolute time elements are elements in which every time value is the Elapsed Time since the start of the procedure. To change from Relative to Absolute, simply remove that part of the code that sets T = 0 and add T to those elements that now have a time value of 0.

Full Headers – Nine Lines of Header

The above example uses the "Full" Header format, with nine lines of header information. Keep in mind that the "start" date and time are defined the moment the procedure is loaded to a Box, irrespective of the #START command. Note that times contain colons and the hour does not necessarily contain a leading zero if the hour is less than 10; however, if the hour is 0, then a 0 will appear in the hour column. The last line of the header contains the name of the MedState Notation .MPC procedure file that generated the data.

Condensed Headers – Two Lines of Header

The MED-PC IV DISKOPTIONS command permits the user to specify a "CONDENSED" header, which in the Annotated format appears as shown below. Two blank lines still precede each session's data, irrespective of header format.

```
BOX: 1 SUBJECT: 1 EXPERIMENT: 1 GROUP: 3 MSN: MedLab8 Fixed Interval
START: 09/22/04 10:54:47 END: 09/22/04 10:59:51
```

Appendix B | SoftCR™

Each MedLab8 procedure stores IRT data in array C that may be used by the SoftCR™ Cumulative Recorder program to generate a graphical record on screen or to print a Cumulative Record after the data has been collected. Each element in this "Cumulative Record" data array consists of two components. The integer value or value to the left of the decimal point is the time component. The decimal value or value to the right of the decimal point is a SoftCR code component.

Time Components

Time components may be Relative or Absolute. In a Relative file, the time component of a given data element is equal to the elapse time since the previous element. In an Absolute file, it is equal to the elapse time since the beginning of the Record. The elements used in MedLab8 are all Relative with a resolution of 0.1 seconds (100 milliseconds). For example, if array C contained just two elements 35.1 and 33.1, the record would consist of one Response Step at 3.5 seconds ($35 * 0.1$) and a second Response Step 3.3 seconds later at 6.8 seconds on the X-Axis.

Control Code Components

The control code component indicates whether the element is a Response Step, Reinforcement Pip, Pen Reset, Event Pen Up, or Event Pen Down element. Up to 10 Event Pens (0 - 9) and 10 Trace Pens (0 - 9) may be specified in MED-PC. In addition, Resets may be made with the Pen "Up" (no vertical tracing) or "Down." Additional coded information may be possible in the future.

Data Element Format

Each data element must conform to the following format:

nnnnn.xyz

Where:

- nnnnn = Time Component
- xyz = Control Code Component
 - x = Datum Type
 - y = Datum Index
 - z = Don't Care Digit

NOTE: If there are more than three numbers past the decimal point, then the array will be considered invalid and will be ignored by SoftCR.

Allowed datum types and indices are:

nnnnn.1yz = Response or Step

y = Index (0 - 9) for Multi-Trace Files

"NULL" for Single Trace Files

nnnnn.2yz = Reinforcement or Pip

y = Index (0 - 9) for Multi-Trace Files

"NULL" for Single Trace Files

nnnnn.3yz = Reset Trace Pen

For Single Trace data files and y is Pen Mode where:

y = 0; Trace 0 Pen Up During Reset

y = 1; Trace 0 Pen Down During Reset

Note: This format overrides the Up/Down
option in edit parameters.

For Multi-Trace data files:

y = Index (0 - 9)

nnnnn.4yz = Unused

nnnnn.5yz = Set Event Pen To Level 0 ("Down" or at baseline), where

y = Event Pen Number (0 - 9)

nnnnn.6yz = Set Event Pen To Level 1 ("Up"), where

y = Event Pen Number (0 - 9)

nnnnn.7yz = Unused

nnnnn.8yz = Unused

nnnnn.9yz = Unused

Data in the array being plotted that does not conform to the above rules will be ignored.

SoftCR for Windows stores in memory the maximum number of array elements allowed in MED-PC IV, which is currently 1,000,00 elements. The maximum number of arrays allowed per Record is 26 (the MED-PC limit).

Example of SoftCR

Figure B1.1 is an example of what a Fixed Ratio schedule will look like in SoftCR after an experiment is run. The red line records a Step for every correct response that is made. Since this is a Fixed Ratio of 1 schedule the subject was reinforced for each response it made. A reward is recorded as a Pip, or a hash mark on the red line. The black lines at the bottom of the screen are called Event Pens and can be used in a variety of ways for a number of purposes. The black line can go up and down, creating quick Spikes like the ones seen here, or long plateaus that represent certain periods of time during an experiment. Here, the Event Pen 0 records a Spike for every incorrect response that is made. Event Pen 1 records plateaus for Time-Out times, if applicable.

The following programs follow the outline for responses and rewards as described above when looking at SoftCR data:

Fixed Ratio

Fixed Interval

Variable Ratio

Variable Interval

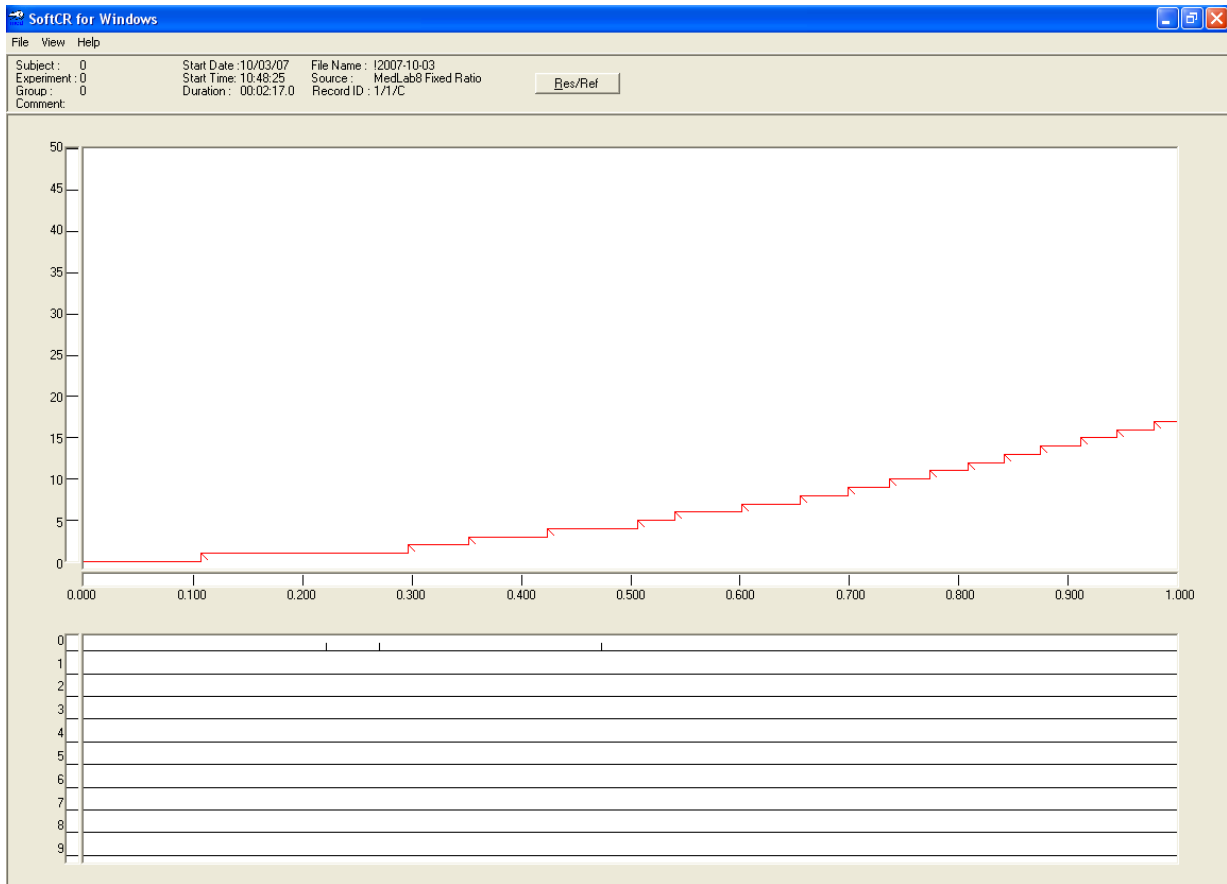
Random Ratio

Random Interval

Chain*

*The Chain program switches the correct and incorrect lever during the program itself, so the correct response Steps and incorrect response Spikes always reflect the current levers during the program.

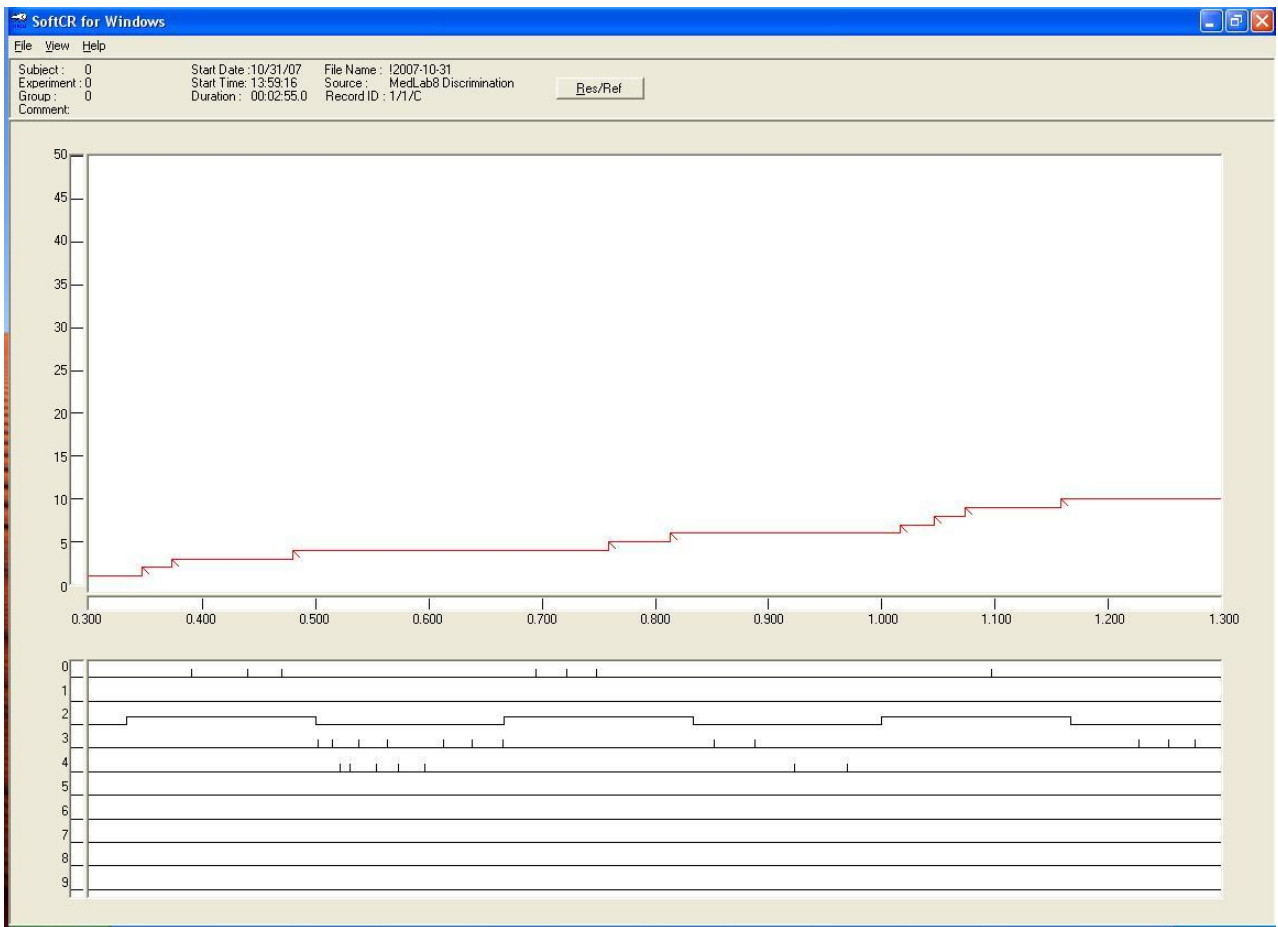
Figure B1.1 – Example of a Fixed Ratio Schedule Shown in SoftCR



Discrimination SoftCR Example

The Discrimination program uses the same Steps, Pips, incorrect responses on Event Pen 0, and Time-Outs on Event Pen 1 as described above. In this case SoftCR Event Pen 2 records a plateau (up) when the stimulus light is On, and records a valley (down) when the stimulus light is Off. During the Stimulus Off period, SoftCR records Spikes on Event Pen 3 for responses on Lever 1 and Spikes on Event Pen 4 for responses on Lever 2. Correct and Incorrect Spikes are not recorded during the stimulus off period; instead the Event Pens 3 and 4 are recorded as Spikes. An example of this is shown in Figure B1.2.

Figure B1.2 – Example of Discrimination Program in SoftCR



Appendix C | Contact Information

Please contact MED Associates, Inc. for information regarding any of our products.

Visit our website at www.med-associates.com for contact information.

For technical questions, email support@med-associates.com.