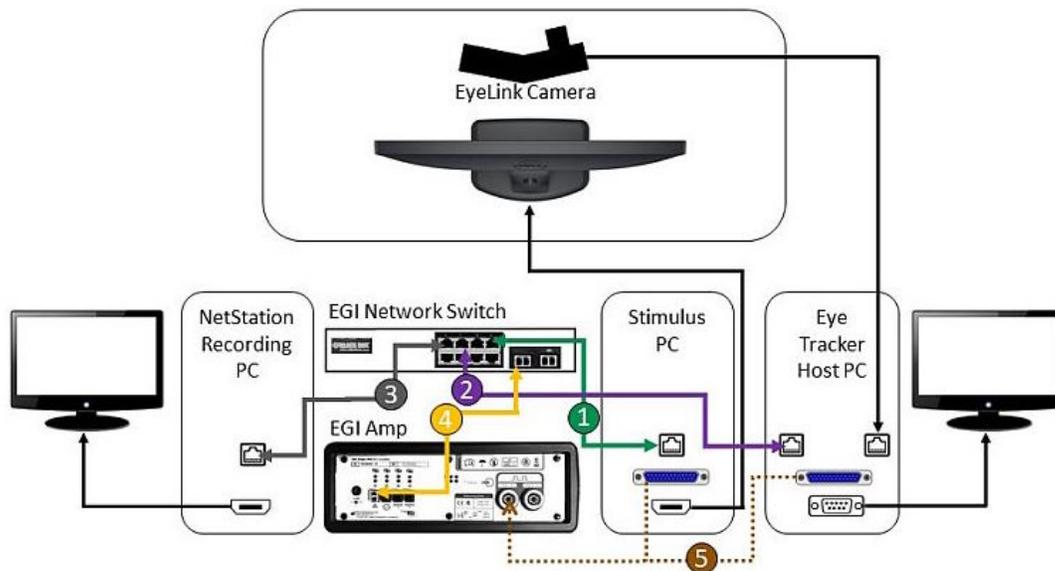


## Adding Net Station Integration to Existing EyeLink Experiments: A Quick Tutorial (version 2.2.1)

This tutorial covers the steps required to add EGI Net Station support to an existing experiment using version 2.2 or later of SR Research Experiment Builder. The latest version of the software adds support for the NTP time synchronization and Net Station's ECI interface to support communication between the display software and Net Station. This is achieved via a NET\_STATION\_CONTROL action which controls Net Station recording operations and sends events to the Net Station data stream. This example (NetStation\_EyeLink\_Simple) is based on the "SIMPLE" example provided by Experiment Builder. Users who are new to the software are encouraged to re-create the SIMPLE example by following the step-by-step instructions provided in the Experiment Builder User Manual ("14 Creating EyeLink Experiments: The First Example"). This example illustrates creating experiments with simultaneous EEG and eye tracking recordings. If you are looking for an example that illustrates using Experiment Builder to control the Net Station without recording eye tracker data, please check out the "NetStation\_NonEyeLink\_Stroop" example and the accompanying tutorial.

The following diagram shows an experiment setup for simultaneous EEG and eye tracking recordings. Please note the Experiment Builder integration uses TCP/IP to control EGI Net Station recording operations and send event information and therefore using a trigger cable (5) to send TTL events to the EGI Amplifier is completely optional.



- ① Ethernet Link between Network Switch and Stimulus PC
- ② Ethernet Link between Network Switch and EyeLink Host PC
- ③ Ethernet Link between Network Switch and Netstation PC
- ④ Fibre optic Link between Network Switch and EGI Amplifier
- ⑤ (Optional) EGI Trigger Cable from Display PC or EyeLink Host PC to EGI Amplifier

Adding EGI Net Station support to an existing Experiment Builder project involves a few basic steps:

- 1) Configuring preferences in Experiment Builder.
- 2) Adding nodes to control the start and stop of the Net Station recordings.
- 3) Sending event markers to Net Station.
- 4) Configuring network settings for the Display Computer and EyeLink Host PC.

This tutorial assumes that the user already has the basic experiment programmed and tested. Although the discussion is based on the Simple example, steps covered here can be easily applied to any experiments programmed with Experiment Builder.

Please report all functionality comments and bugs to [support@sr-research.com](mailto:support@sr-research.com).

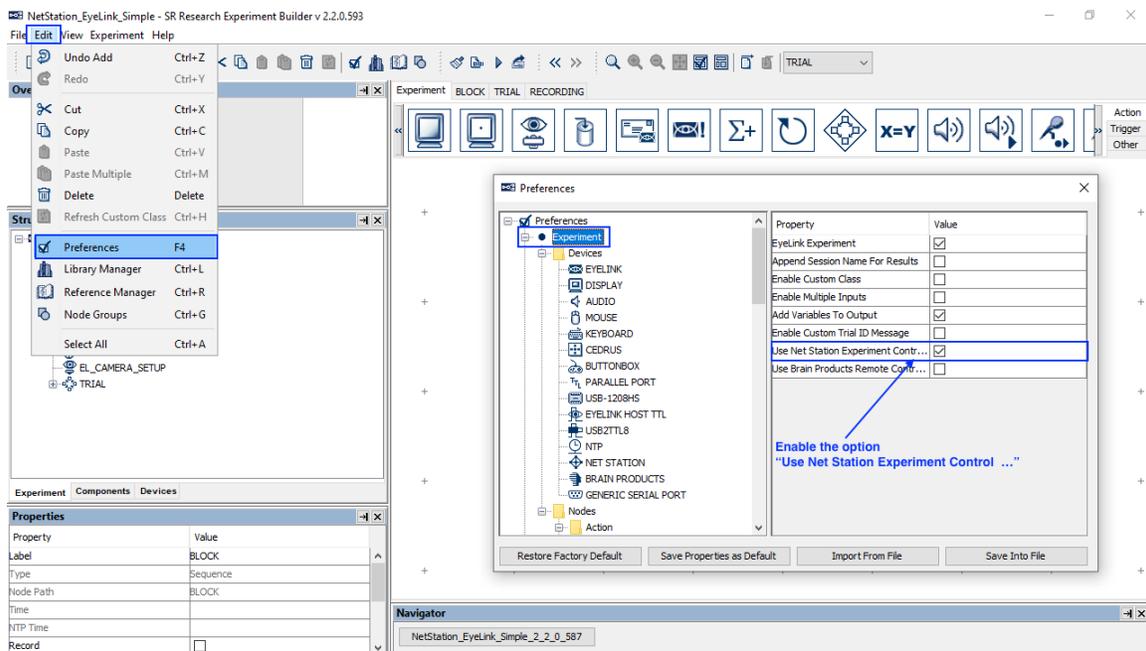
# 1 Configuring Experiment Builder Preferences

The integration between Experiment Builder and Net Station uses the Experiment Control Interface (ECI), which uses TCP/IP to control Net Station recording operations and to send event information to Net Station. The other aspect of the integration is the use of NTP time protocol for communicating clock and timing information between computers and devices so that the events recorded in Experiment Builder are synchronized with the EEG data collected by EGI's amplifiers. Users first need to configure the following Experiment Builder preferences to enable the Net Station ECI and NTP components.

## 1.1 Enabling Net Station ECI and NTP

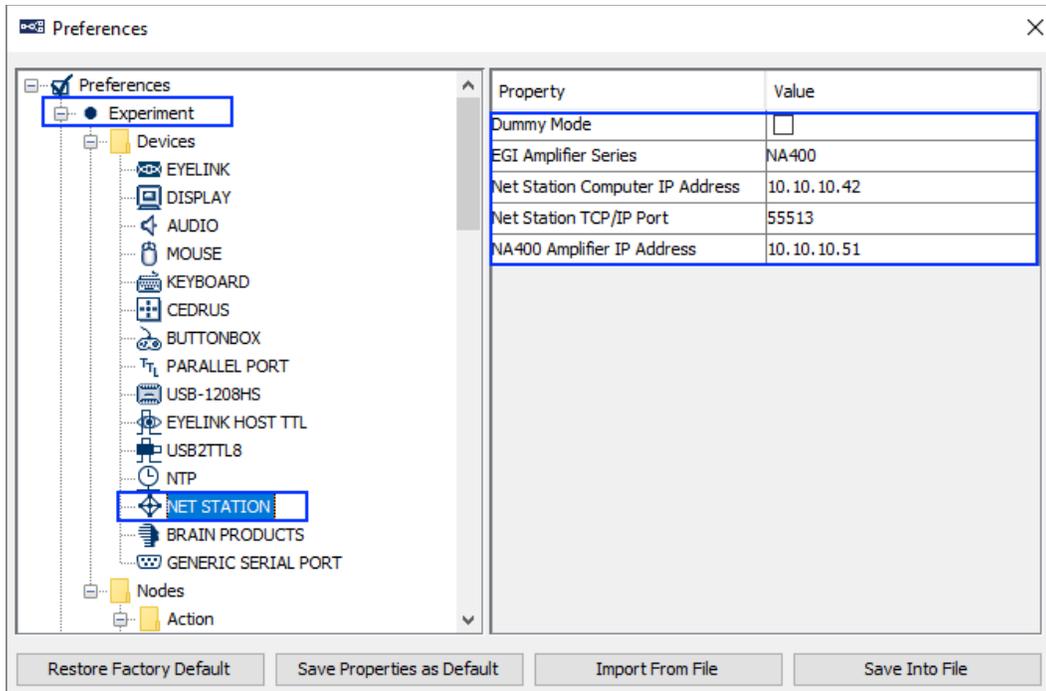
Follow the steps below to enable the Net Station ECI communication and NTP protocol.

- 1) Select “Edit -> Preferences” from the application menu bar or press the shortcut key “F4” on Windows.
- 2) Click “Preferences -> Experiment” and check the “Use Net Station Experiment Control Interface” option. Toggling this option will enable the “Net Station” device and the “Net Station Control” action in the project. It will also enable the NTP time option for all of the triggers and actions. Note that enabling this option also automatically enables the “Enable NTP Clock” option.



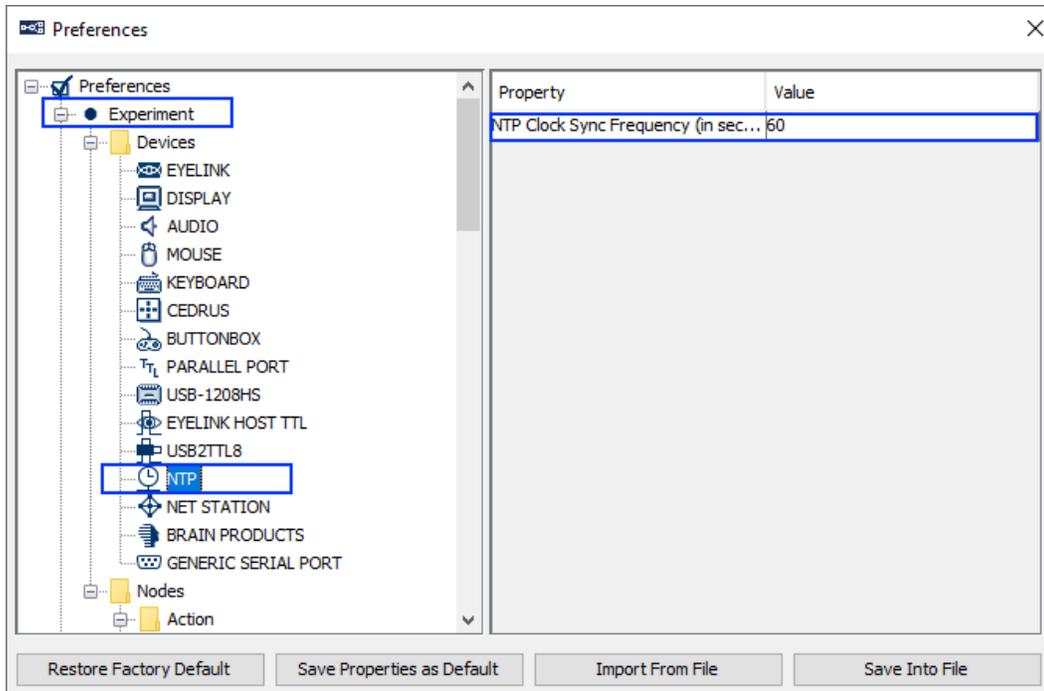
## 1.2 Review the Net Station Device Settings

To configure the Net Station device, go to “Preferences -> Experiment -> Devices -> Net Station”. Make sure the EGI Amplifier Series setting matches the amplifier being used. Users may also configure Net Station settings, including the IP address and Ethernet port used by the display computer to establish the TCP/IP connection to the Net Station host computer. The “Dummy Mode” option may be enabled to simulate the connection to the Net Station host computer. This allows users to test run their projects without an actual connection to the Net Station host computer, showing the simulated operations and printout of event data to be sent. Users should make sure this option is turned off before running the actual EEG experiments.



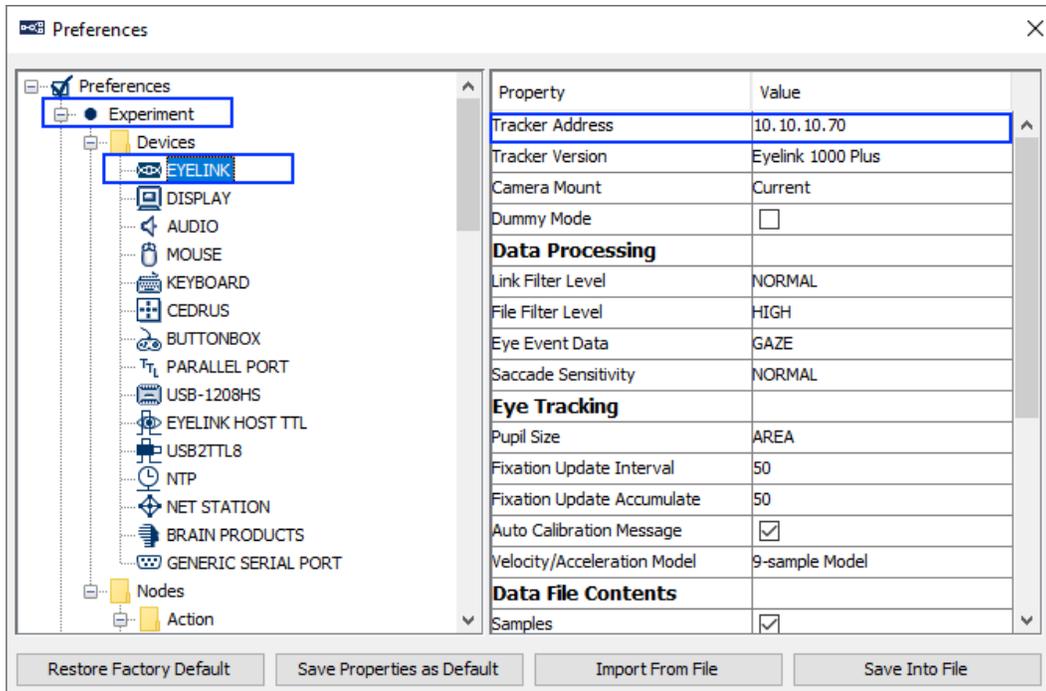
### 1.3 Review the NTP Device Settings

The NTP protocol is the mechanism used for communicating clock and timing information between computers and device. By default, Experiment Builder performs a clock synchronization every 60 seconds between the EEG amp, display computer, and the EyeLink host computer. Each synchronization will do a reading of the current Host PC time, Display PC time, and EEG Amplifier clock, and send a “\_\_NTP\_CLOCK\_SYNC\_\_” message to the EDF file and Net Station to report the times from the three clocks. All of the NTP time estimates for the events are based on the display computer clock. To review the NTP device settings, click “Preferences -> Experiment -> Devices -> NTP”. We recommend users keep the default settings.



## 1.4 Configuring EyeLink Tracker Address

Users should also make sure the EyeLink device is properly configured. To configure the EyeLink device, go to “Preferences -> Experiment -> Devices -> EyeLink”. To communicate with the Net Station computer, the IP address of the EyeLink Host PC should be set to 10.10.10.x. In this example, we have set the host computer IP address to 10.10.10.70 in the Tracker Address property. The user should also check that the proper Tracker Version and Camera Mount settings are in use. Please see section 4 for instructions on configuring the IP address of the display computer and EyeLink host computer.



## 2 Controlling Net Station Recordings

During an EEG experiment, the Display PC will need to connect to the Net Station host PC, send commands and event markers to the Net Station, and perform clock synchronization. At the end of the experiment, the Display PC will send a disconnect command to the Net Station host PC to terminate the session. The experimenter will still need to manually provide the name of the EEG recording file on the Net Station control computer in order to start a new experiment.

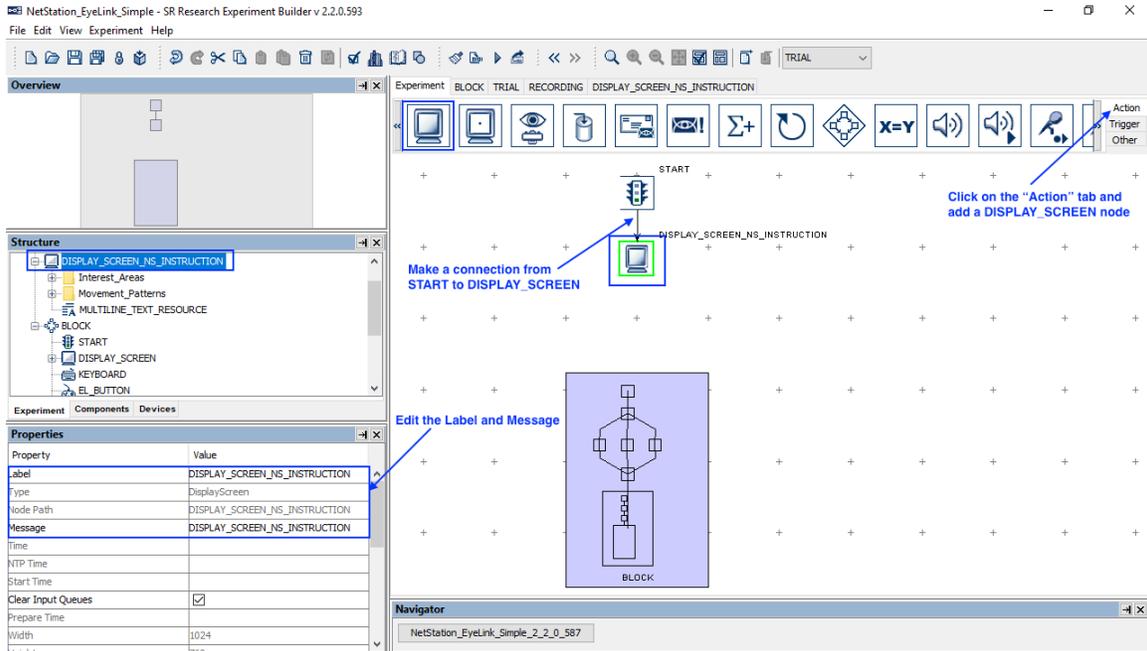
When the Net Station Experiment Control Interface is enabled, Experiment Builder will automatically connect/disconnect to the Net Station and perform the clock synchronization. Users can add NET\_STATION\_CONTROL actions into the experiment to control the starting and stopping of the EEG recordings (section 2.1), marking the start/end of the trials (section 2.2), and sending event markers to Net Station (section 3).

### 2.1 Starting and Stopping Net Station Recordings

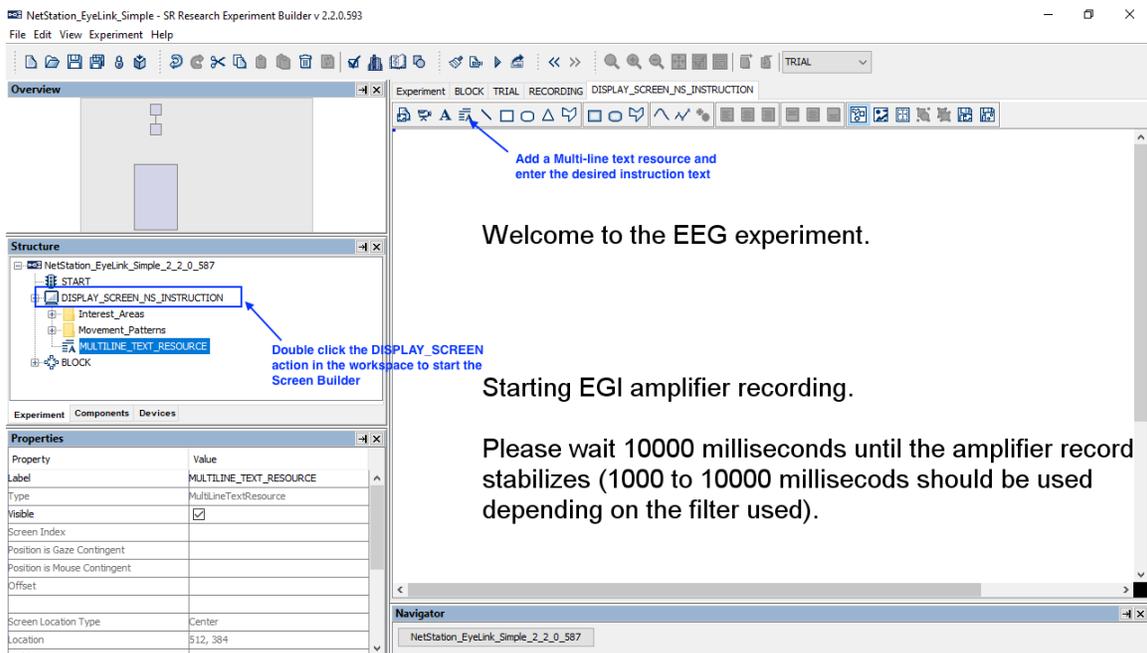
The “START RECORDING” and “STOP RECORDING” options of the NET\_STATION\_CONTROL node allow users to control EEG recordings. In a typical Net Station session, users will need to start and stop recording only once, using a “START RECORDING” action at the beginning of the experiment and a “STOP RECORDING” action at the end of the experiment, or to start and stop recording once per block. It is not recommended to start and stop Net Station recordings too often (e.g., at the trial level), as the EEG acquisition needs some time to stabilize once a recording has started. According to the EEG manufacturer, the best practice is to add a delay following the start of the recording to ensure the amplifier recording has stabilized (1 to 10 seconds should be used depending on the filter used). The NET\_STATION\_CONTROL action has a “Stabilization Period” property that adds the required delay (10000 ms by default) to the program execution before the experiment flow moves to the next node. As a result, users may wish to add an instructions screen right before the start of the Net Station recording.

The following section details how to start and stop the EEG recording at the experiment level. The same steps can be performed if users need to perform the EEG recordings at the block level or at the trial level.

- 1) Go to the topmost experiment level.
- 2) Select the “Action” tab of the Component Toolbox and drag a “DISPLAY\_SCREEN” node into the experiment graph. Edit the label of the node and fill out a message. Connect by clicking and dragging from the START node to the newly added DISPLAY\_SCREEN node.

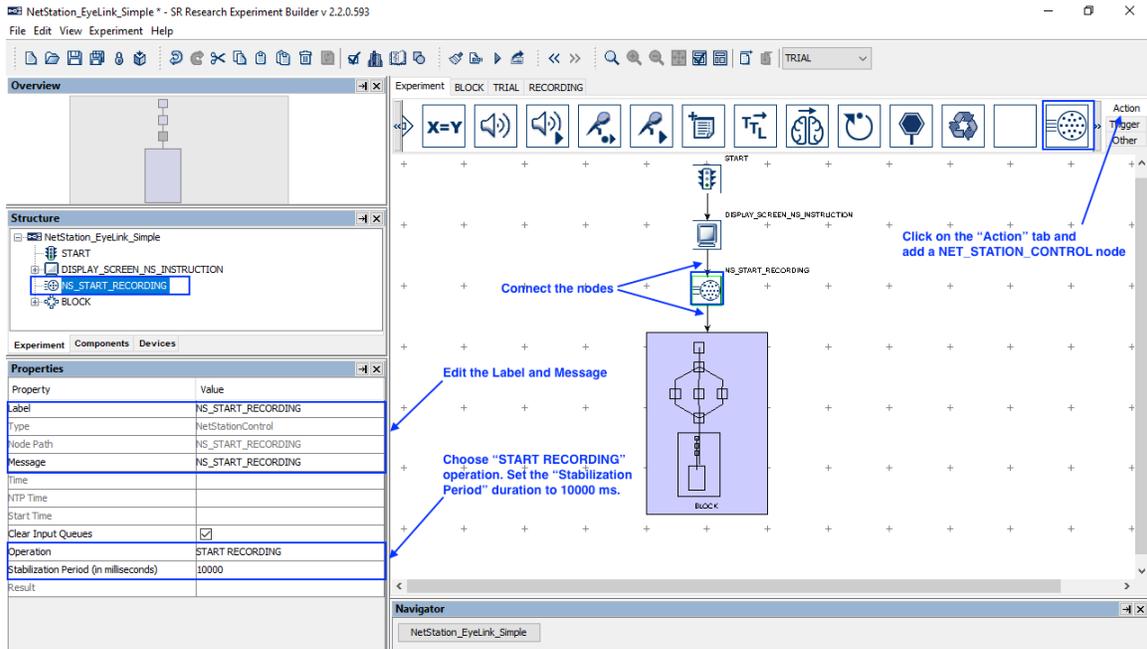


- 3) Select the newly added DISPLAY\_SCREEN action. Double click to start the Screen Builder. Add a MULTILINE\_TEXT\_RESOURCE to the screen, and enter the desired instruction text.

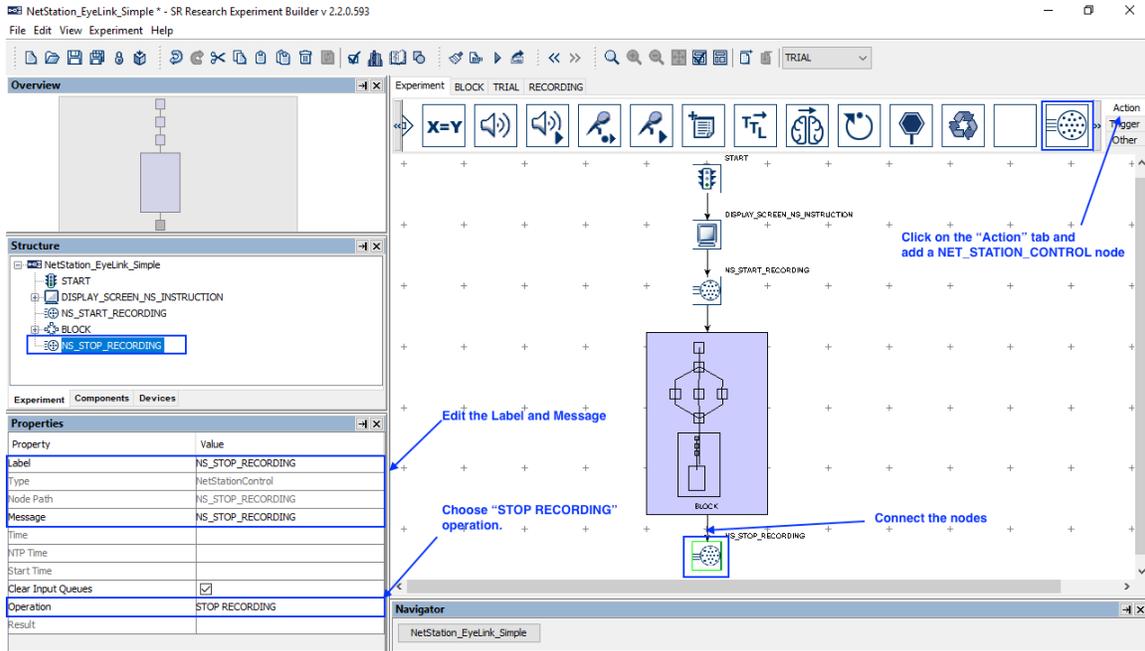


- 4) Select the “Action” tab of the Component Toolbox, click the NET\_STATION\_CONTROL action (  ), and drag the node into the graph. Edit the “Label” and “Message” properties of the node. Choose the “START RECORDING” option from the “Operation” dropdown list. Set the “Stabilization

Period” to 10000 ms—note that the time required until the amplifier recording stabilized depends on the recording frequency and filter used in the Net Station recording. Please consult your EGI Net Station User Manual for the optimal stabilization duration. Then draw connections from the DISPLAY\_SCREEN to the NET\_STATION\_CONTROL node, and from the NET\_STATION\_CONTROL node to the BLOCK sequence.



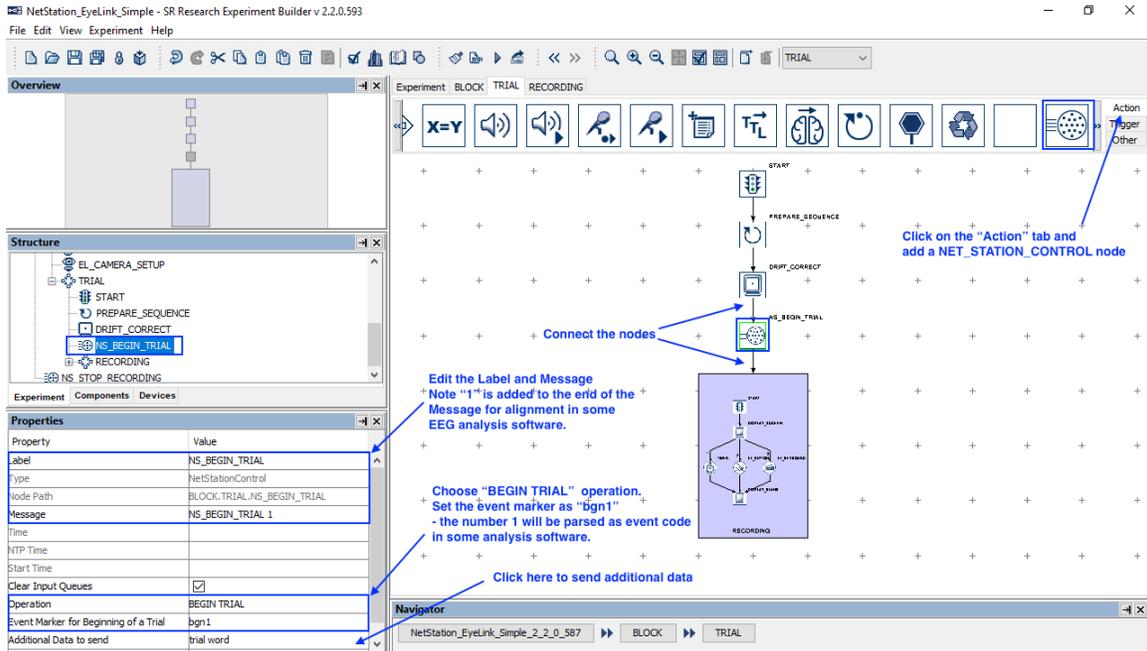
- 5) Select the “Action” tab of the Component Toolbox and add a NET\_STATION\_CONTROL node to the graph. Edit the “Label” and “Message” properties of the node. Choose “STOP RECORDING” from the “Operation” dropdown list. Now connect from the BLOCK sequence to the NET\_STATION\_CONTROL node.



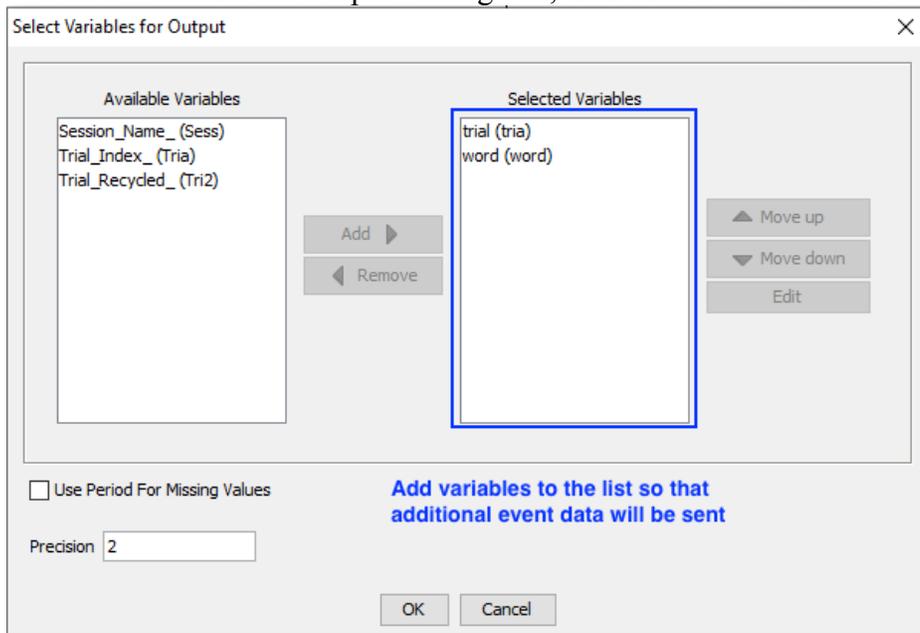
## 2.2 Marking the Beginning and End of a Trial

As mentioned above, users should typically start and stop the Net Station recordings at the experiment or block level. Users may then send event markers to Net Station to mark the beginning and end of each trial. In this example, we will use a NET\_STATION\_CONTROL action right before the RECORDING sequence to log a “bgn1” event in Net Station data stream corresponding to the beginning of the trial, and another NET\_STATION\_CONTROL action right after the RECORDING sequence to send out a trial-specific (TRSP) event.

- 1) Select the “Action” tab of the Component Toolbox and add a NET\_STATION\_CONTROL node to the graph, then edit the “Message” properties of the node to “NS\_BEGIN\_TRIAL 1”—the “1” at the end of the message can be parsed as trigger data by some EEG analysis software, and corresponds to the event marker we will send to Net Station. Choose “BEGIN TRIAL” from the “Operation” dropdown list, which will show the Event Marker for Beginning of a Trial field. Any code up to four characters may be used as the Event Marker for Beginning of a Trial; however, we will use the default “bgn1”—the “1” at the end allows some EEG software to align the event marker with the message in the EyeLink (“NS\_BEGIN\_TRIAL 1”) to easily align the events. Now draw a connection from the DRIFT\_CORRECT node to the newly added NET\_STATION\_CONTROL action, and from the NET\_STATION\_CONTROL action to the RECORDING sequence.



- 2) The optional property “Additional Data to Send” allows the user to specify any project variables to be sent with the event marker. Click the value field to display a “Select Variables for Output” dialog box, then choose the variables to be sent.



- 3) Add a NET\_STATION\_CONTROL node from the “Action” tab of the Component Toolbox into the graph and edit the “Label” and “Message” properties of the node. Choose “END TRIAL” from the “Operation” dropdown list. Click the value field of the “Trial Specific (TRSP) Event” property to display a “Select Variables for Output” dialog box, and choose up to 10 project variables to be sent (to avoid flooding the network communication). Then draw a

connection from the RECORDING sequence to the NET\_STATION\_CONTROL action.

The screenshot displays the SR Research Experiment Builder interface. The main workspace shows a sequence of nodes: START, PREPARE\_SEQUENCE, DRIFT\_CORRECT, NS\_BEGIN\_TRIAL, and RECORDING. A new node, NET\_STATION\_CONTROL, is being added to the sequence. Annotations with blue arrows point to specific actions:

- "Click on the 'Action' tab and add a NET\_STATION\_CONTROL node" points to the 'Action Trigger' icon in the top toolbar.
- "Edit the Label and Message" points to the 'Label' and 'Message' fields in the Properties panel.
- "Choose 'END TRIAL' operation and select variables to be included in the event data" points to the 'Operation' field in the Properties panel.
- "Connect the nodes" points to the connection line between the RECORDING node and the NET\_STATION\_CONTROL node.

The Properties panel on the left shows the following details for the selected NET\_STATION\_CONTROL node:

Property	Value
Label	NS_END_TRIAL
Type	NetStationControl
Node Path	BLOCK.TRIAL.NS_END_TRIAL
Message	NS_END_TRIAL
Time	
NTP Time	
Start Time	
Clear Input Queues	<input checked="" type="checkbox"/>
Operation	END TRIAL
Trial Specific (TRSP) Event	Session_Name_Trial_Index_Trial_Recyc...
Result	

The Navigator at the bottom shows the current sequence: NetStation\_EyeLink\_Simple\_2\_2\_0\_587 >> BLOCK >> TRIAL.

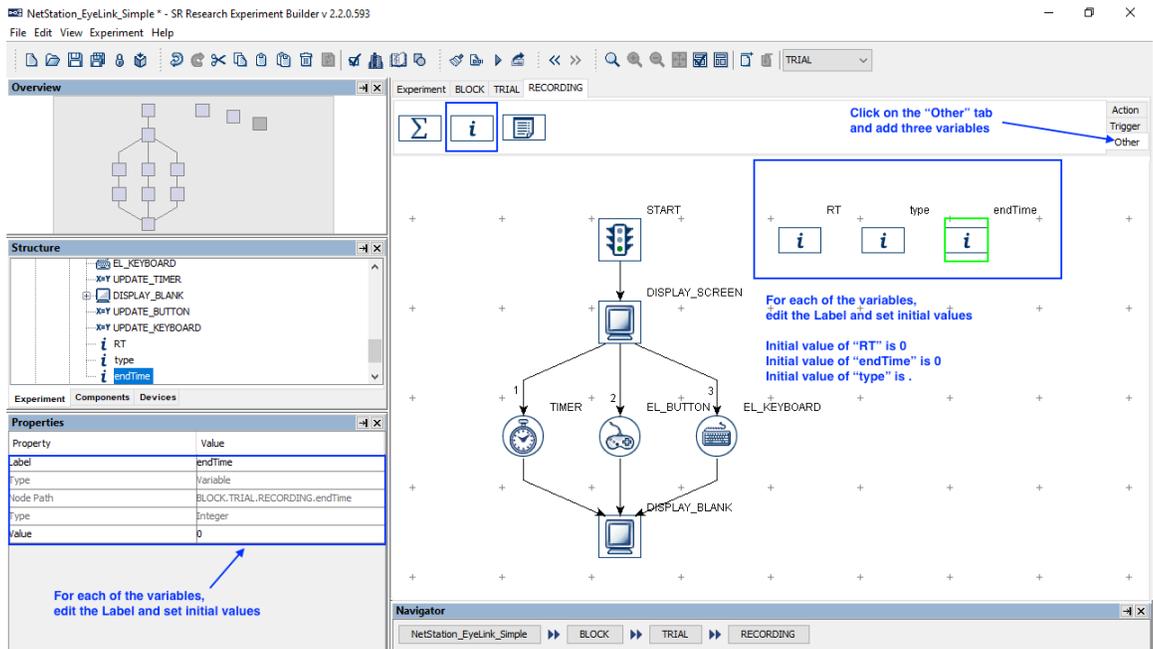
### 3 Updating response data and sending event markers to Net Station

To make sure events recorded in Experiment Builder are synchronized with the EEG data collected in Net Station, users can include a single NET\_STATION\_CONTROL action at the end of each trial that sends a list of trial event markers to Net Station. With the “SEND EVENT” operation, users can specify all of the critical events in the trial to be sent to Net Station, such as display and audio stimulus onsets, participant responses, blinks, etc. (It is highly preferred to use a single SEND EVENT operation to send multiple event markers at the end of the trial, rather than using individual SEND EVENT actions after each trial event. This ensures that the execution of time-critical events in the experiment is not delayed.)

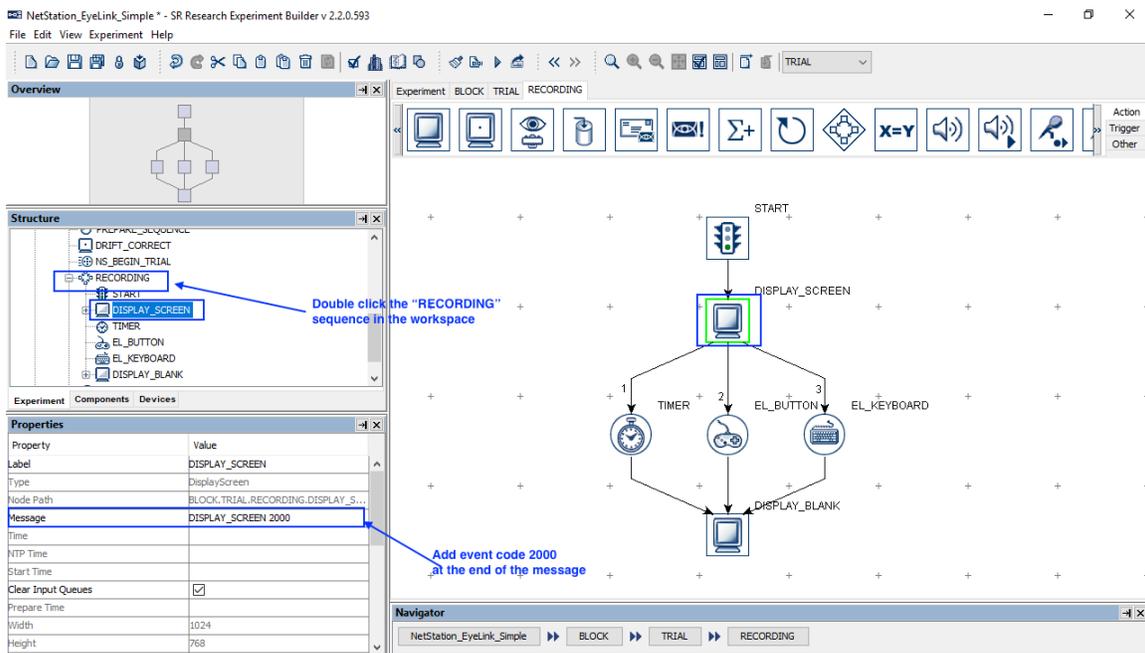
**IMPORTANT:** Do not send simultaneous events (i.e., events with the same Start Time value) to Net Station, as simultaneous events will not be accessed properly in Net Station.

In this example, we illustrate using a NET\_STATION\_CONTROL action to mark the onset of the DISPLAY\_SCREEN and to send the participant’s response data to the EEG data stream. First, we will add three variables to collect the response time, type of response, and calculate the RT, then set the project to update the values of these variables online.

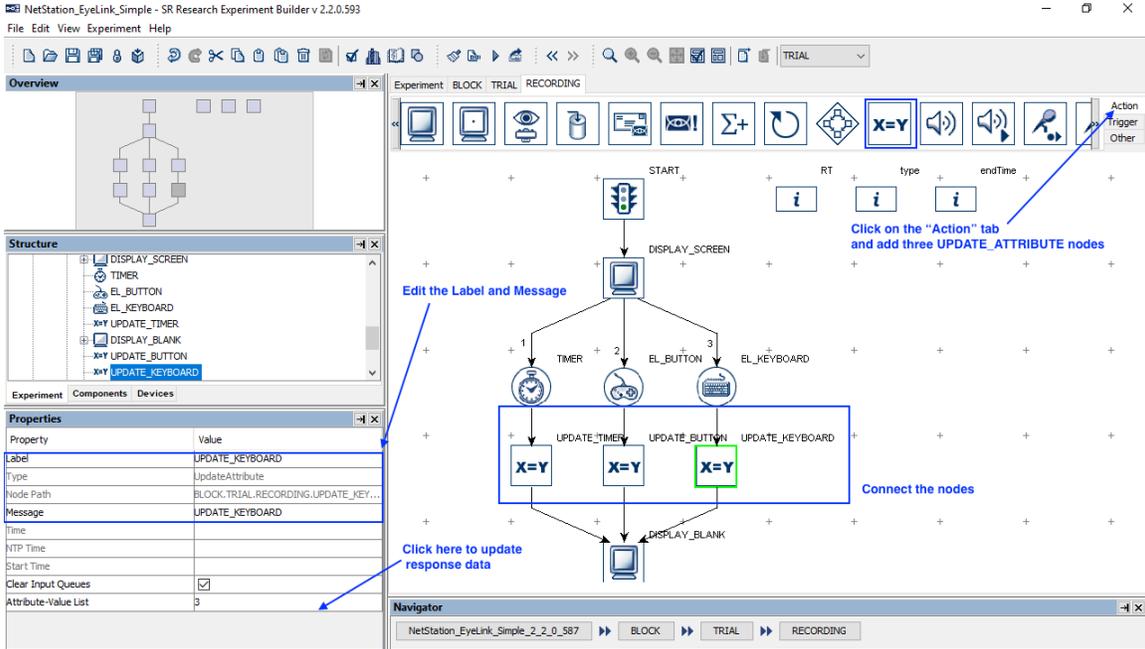
- 1) Select the “Other” tab of the Component Toolbox and add three Variable nodes to the graph to record the participant’s response. For each of the variables, edit the “Label” (as “RT”, “type”, and “endTime”, respectively), and set an initial value of “0” in the “Value” field.



- To align the eye tracking and EEG data, we will send an event marker to the EEG data stream, and at the same time, send a message to the EDF file that includes the trigger data. In our example, we will send an event marker for the time when the DISPLAY\_SCREEN is shown to the participant during experiment. Select the existing DISPLAY\_SCREEN node. Change the Message text to “DISPLAY\_SCREEN 2000”—the “2000” refers to the event marker we will send to Net Station. Configuring the event marker will be discussed in step 6.

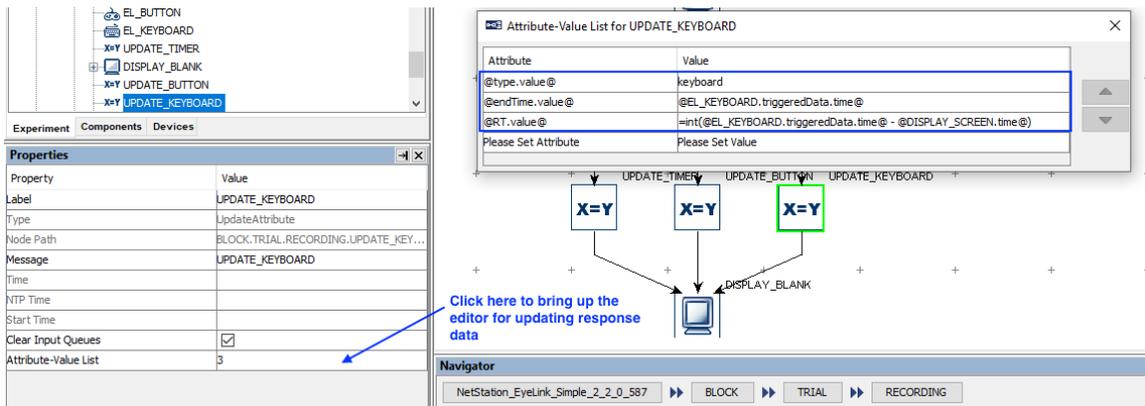


- Select the “Action” tab of the Component Toolbox and add an UPDATE\_ATTRIBUTE action following each of the existing trigger nodes. Edit the “Label” of the newly added nodes as “UPDATE\_KEYBOARD”, “UPDATE\_TIMER”, and “UPDATE\_BUTTON”. Connect from EL\_KEYBOARD to UPDATE\_KEYBOARD, from TIMER to UPDATE\_TIMER, and from EL\_BUTTON to UPDATE\_BUTTON. Then connect from each of the UPDATE\_ATTRIBUTE nodes to the DISPLAY\_BLANK node.



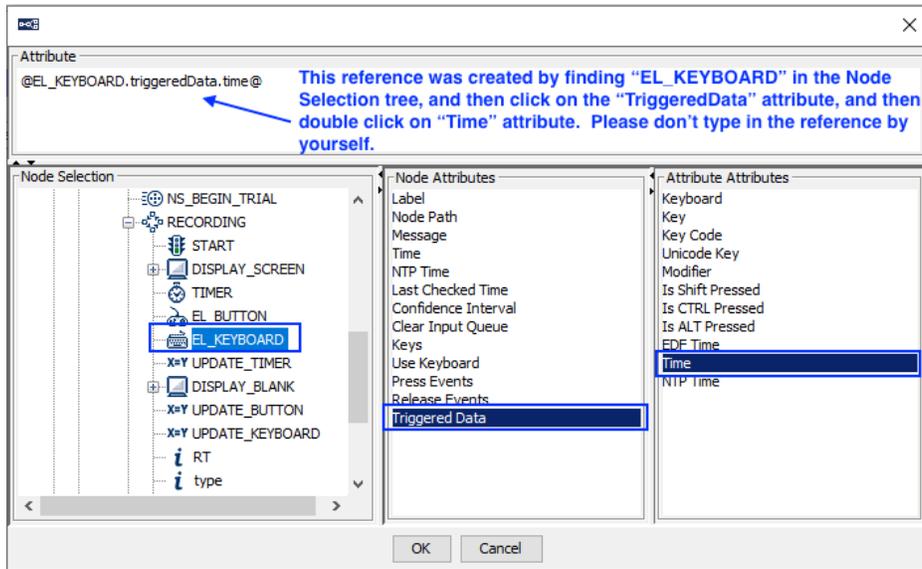
4) For each of the newly-added UPDATE\_ATTRIBUTE nodes, click the value field of the “Attribute-Value List” to update the participant’s response data. Use the following for the Keyboard response:

Attribute 1	@type.value@
Value 1	keyboard
Attribute 2	@endTime.value@
Value 2	@EL_KEYBOARD.triggeredData.time@
Attribute 3	@RT.value@
Value 3	=int(@EL_KEYBOARD.triggeredData.time@ - @DISPLAY_SCREEN.time@)”

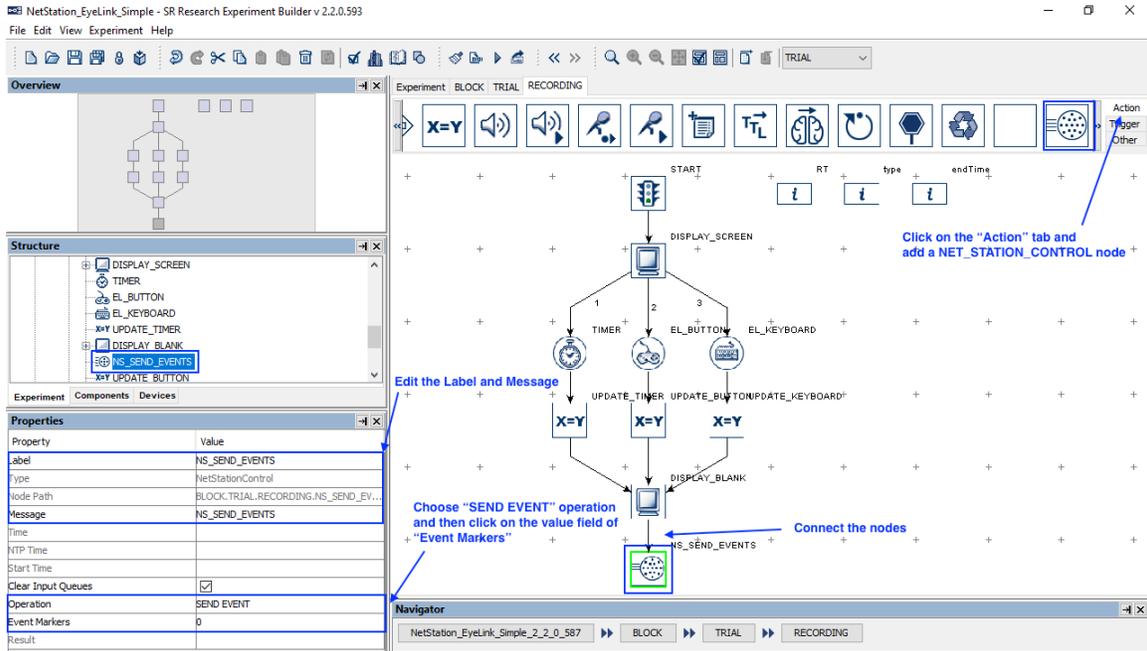


Note that the actual time when the display is presented on the screen corresponds to @DISPLAY\_SCREEN.time@, not @DISPLAY\_SCREEN.startTime@—the startTime property is the time when the DISPLAY\_SCREEN action starts

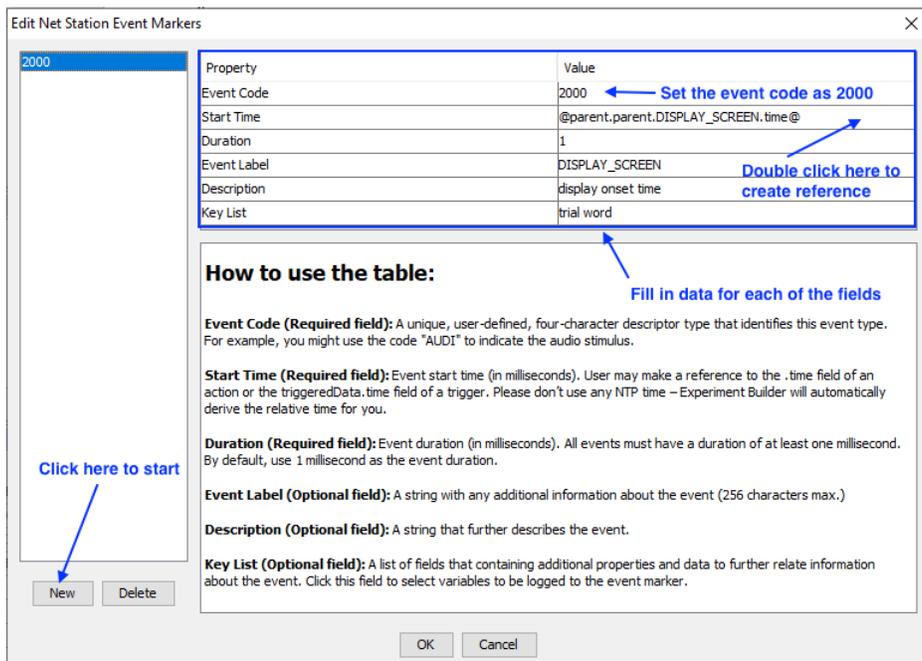
preparing the screen to be flipped. Likewise, the time of the keyboard response should be `@EL_KEYBOARD.triggeredData.time@` from the “Attribute Attributes” panel (see the Figure below), and not `@EL_KEYBOARD.time@` from the “Node Attributes” panel—the `triggeredData.time` is the time when the response key is pressed, while the latter is the time when the `EL_KEYBOARD` trigger fires. Note also that an “=” sign is added before the RT calculation `"int(@EL_KEYBOARD.triggeredData.time@ - @DISPLAY_SCREEN.time@)"` so an expression can be created in the cell.



- 5) Next, open the “Action” tab of the Component Toolbox and add a “NET\_STATION\_CONTROL” action to the graph. Connect from the “DISPLAY\_BLANK” node to the newly added NET\_STATION\_CONTROL node. Edit the Label and Message properties of the node, and set the “Operation” to “SEND EVENT”.

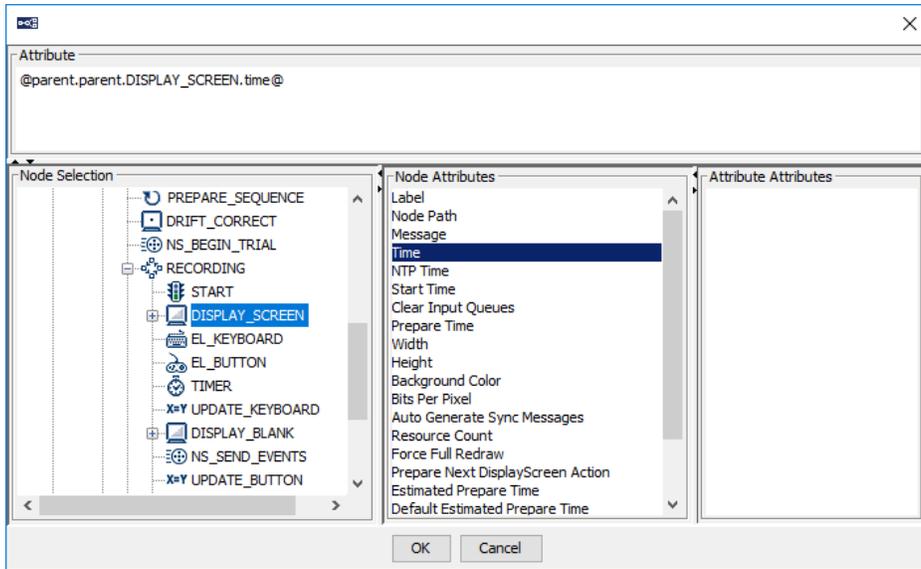


- 6) To configure the events to be sent, click the value field of the “Event Markers” property. This will display an “Edit Net Station Event Marker” dialog box. Click the “New” button to add a new event marker, then enter values for each of the fields. We will send the first event marker to indicate the onset of the DISPLAY\_SCREEN.



**Event Code:** This must be a distinct four-character code. In this example, we will use the code “2000”. This corresponds to the trigger value that we added to the message of the DISPLAY\_SCREEN.

**Start time:** This should refer to the time of the screen onset. We will set this to “@parent.parent.DISPLAY\_SCREEN.time@”—please don’t type in the text here; instead, click the value field to display the [ ... ] button, then click the button to open the Attribute Editor. You can use the Attribute Editor to find the desired attribute and create the reference automatically (see the figure below). The value entered must be a time value in the Display PC clock, and not the NTP clock (Experiment Builder will automatically do the necessary time conversion and offset adjustments).



**Duration:** Set this to 1 for an event of 1 ms duration.

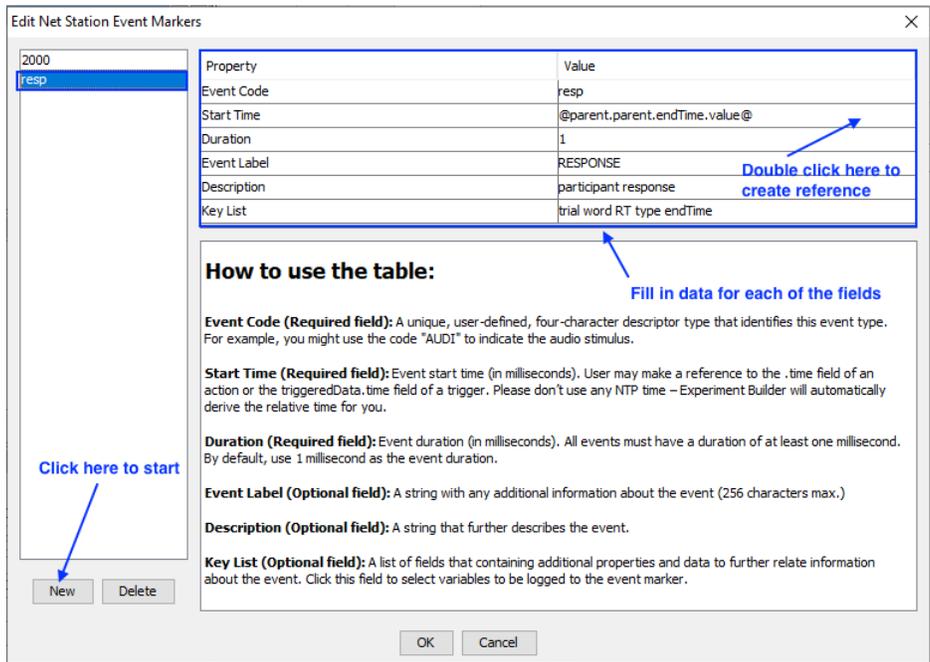
**Event Label:** This can be the label of the node used in the Experiment Builder project. Here we have set it to “DISPLAY\_SCREEN”.

**Description:** It can be any string that further describes the event marker.

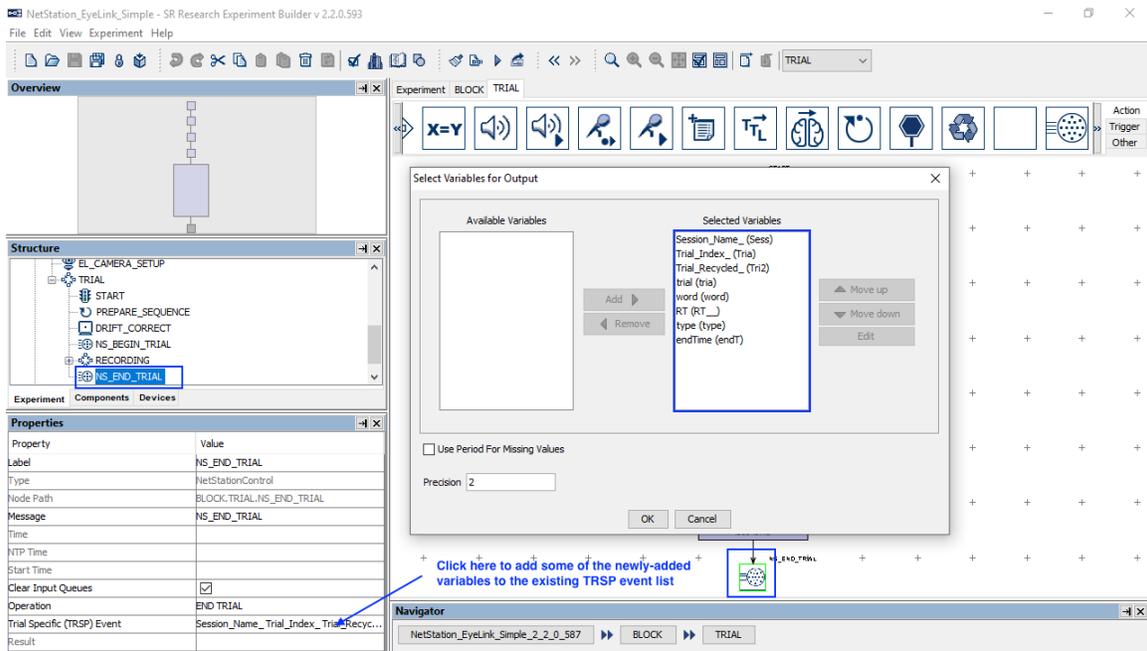
**Key List:** This allows users to include additional data fields along with the event marker if desired. Click the value field to bring up a “Select Variables for Output” dialog box in which users can select data to send with the display screen event. In this case, we will add the “trial” and “word” variables to the event marker.

- 7) Click the “New” button to add another event marker for the participant response. Note the following event details for this example.

<b>Event Code</b>	resp
<b>Start Time</b>	@parent.parent.endTime.value@
<b>Duration</b>	1
<b>Event Label</b>	RESPONSE
<b>Description</b>	participant response
<b>Key List</b>	List of variables: trial word RT type endTime



- 8) Note that at this point, new variables have been added to the project since we configured the list of Trial Specific (TRSP) Events sent with the END TRIAL operation. To make sure these new variables are included in the TRSP list, go back to the NS\_END\_TRIAL node (see Step 3 of Section 2.2) and click the Value of the Trial Specific (TRSP) Events property.



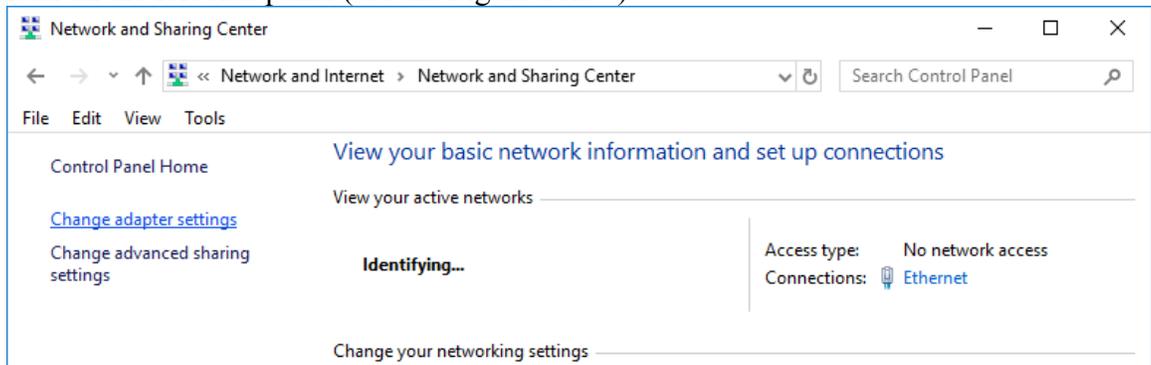
## 4 Configuring Network Settings for the Computers

In order for the Display PC running Experiment Builder, the Net Station PC, and the EyeLin Host PC to communicate with each other, all three computers must be connected via a network switch or hub. Users should refer to the EGI Net Station User Manual for instructions on configuring the Net Station computer and EEG amplifier IP address. The following sections discuss how to configure the IP addresses of the Display PC and EyeLink eye tracker.

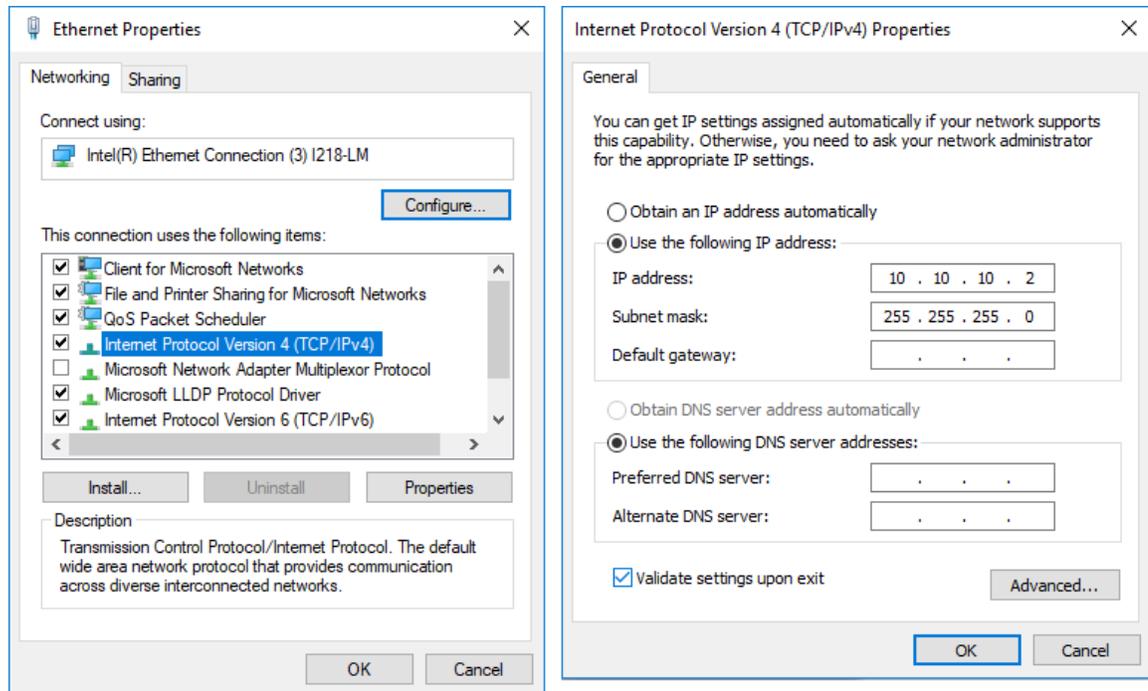
### 4.1 Configuring the Display Computer IP Address

If your EGI Net Station uses its default IP address, the IP address of the display computer should also be configured to the same 10.10.10.x subnet. The following instructions are based on Windows 10; instructions for other Windows operating systems may vary slightly.

- 1) From the Start menu, select “Windows System -> Control Panel”.
- 2) Click on the “Network and Internet” icon, and then select the “Network and Sharing Center” icon. In the following Screen, choose “Change adapter settings” icon on the left side panel (see the Figure below).



- 3) Check the list of installed components to make sure a network card is detected. If not, install the driver for the network card.
- 4) Double click on the network card icon that represents the network card that will be connected to the EyeLink Host PC.
- 5) Select the “Properties” button.
- 6) Select the “Internet Protocol Version 4 (TCP/IPv4)” and then click on the “Properties” button (see the figure below).



- 7) Select the “Use the following IP address” radio button. Enter the IP address “10.10.10.2”. The last digit of the IP address can be increased as necessary to account for other computers on the network. Enter the subnet mask of “255.255.255.0”. Leave the default gateway and other settings blank.
- 8) Click on “OK” to return to the Properties dialog. Click “OK” again to save your changes. Click “Close” to exit from the network card dialog.

## 4.2 Configuring the Host Computer IP Address

You will need to modify the “host\_address” parameter on the Host PC by setting it to the IP that you want to use. For example, if your intended IP address is 10.10.10.70, use the following.

```
host_address = 10.10.10.70, 255.255.255.0
```

The “host\_address” parameter comes from `eyenet.ini`, but it is best to change it by adding the above line to `final.ini`. The instructions differ slightly depending on the eye tracker used.

**If you are using an EyeLink II or EyeLink 1000 eye tracker, please follow the steps below:**

The `final.ini` file can be found in the “`C:\eyelink2\exe`” or “`C:\elcl\exe`” directory of the host PC. You may want to boot the host computer into the Windows partition to edit the configurations.

**If you are using an EyeLink 1000 Plus or EyeLink Portable Duo, please follow the steps below:**

- 1) The final.ini file can be found in the File Manager. To access the File Manager, simply exit the Host application by clicking the Exit / Exit EyeLink button or pressing Ctrl-Alt-Q. In the File Manager, navigate to the /elcl/exe/ directory, select the file “final.ini”, and click the “Edit” tab in the Preview window. Then add the “host\_address” line to the final.ini file.
- 2) Then find the file called start\_tk (also in /elcl/exe/). In that file, look for the DISPLAYIP in full\_reset\_ip and set to the IP you want to use (e.g., DISPLAYIP=10.10.10.70).
- 3) Reboot the host computer.