Contrast Sensitivity: Lesson 1

This **step-by-step** tutorial teaches you how to build and run your first experimental design for measuring contrast sensitivity. More specifically, you will learn how to:

1) create the hierarchical structure of a basic experiment,
2) customize the events,
3) use variables to connect procedural and stimulus events,
4) run the experiment,
5) and visualize the results!

BASIC TASK

The aim of this experiment is to measure contrast detection threshold for a Gabor stimulus of given spatial frequency and size using a staircase method and a horizontal/vertical discrimination procedure.

Step 1: Opening the "Designer" Panel

Launch Psykinematix, and select the **Designer** panel by clicking on its icon in the toolbar.
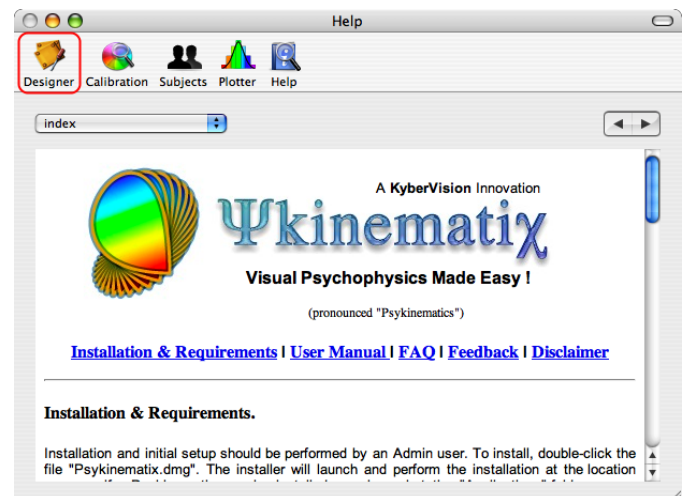
Step 2: Adding an Experiment Event

The **Experiment Designer** panel presents a hierarchical view of the experiments. Before going further, make sure to deselect any event by clicking on an empty row or Apple-clicking on the selected event to deselect it.

Now, create a new **group** event by clicking on the folder icon with the '**+**' symbol in the bottom toolbar.

Tip: *A group event embeds one or several events.*
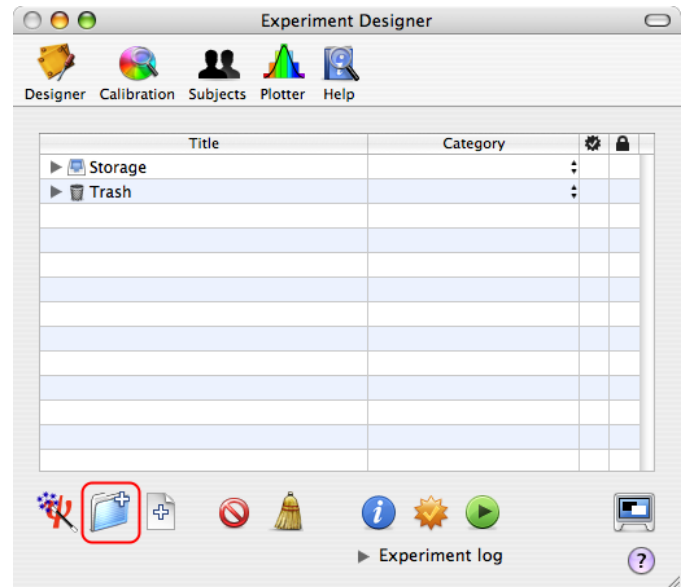
The new event appears at the top in the table with a default title (***New Events***). Change its title to ***Contrast Sensitivity*** to reflect the experiment purpose (double-click on the title to edit it).
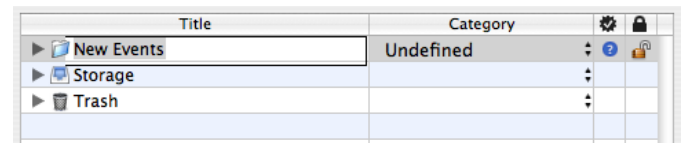
Each event is characterized by a category that defines its function inside your experimental design. To change the default category (**Undefined**), use the pop-up menu to select the **Experiment** entry. Note how the small icon in front of the event changed from a small folder to a small red **psi** icon specific to the **Experiment** event.
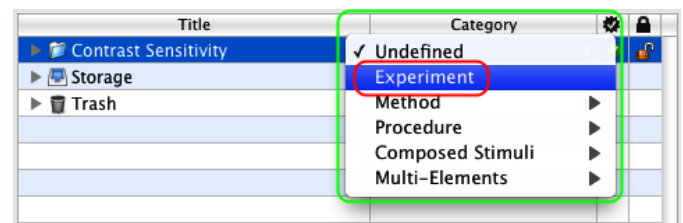
Tips:
*Each category of events has its own small icon to depict its function.*
The Undefined category can still be used to group several experiments under one roof (eg: all experiments related to the same study).

Psykinematix: Visual Psychophysics Made Easy on Mac OS X

Step 3: Adding a Staircase Method

Select the **Experiment** event you just created (
Contrast Sensitivity), and add a new **group** event by
clicking on the '**+**' folder icon again.
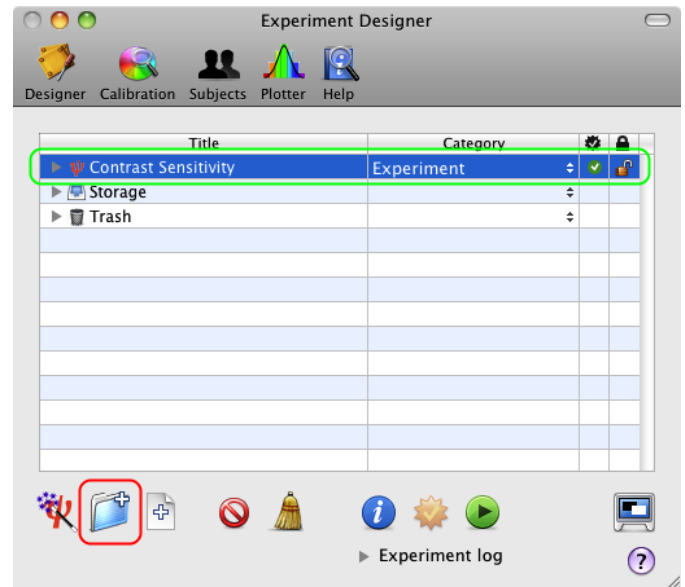
A new **Undefined** event embedded in the **Experiment**
event is automatically revealed with its title ready to be
renamed.
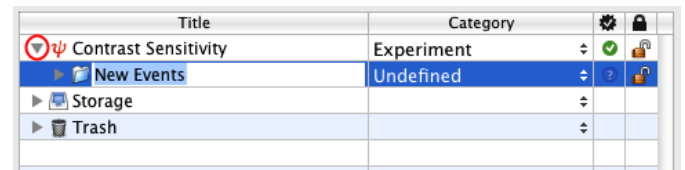
*Tip: Click on the small arrow in front of a group event to expand or collapse the first level of its
hierarchical structure (option-click to reveal the whole hierarchy). The first level can be also revealed or
hidden by selecting the event and pressing the space bar.*

Change the title and category of the new event to
Staircase and **Method** as illustrated.
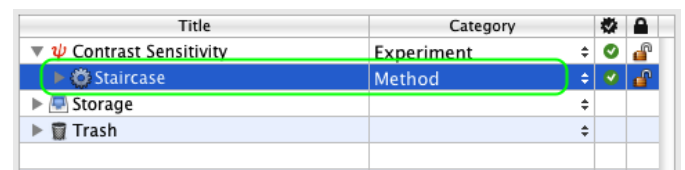
Step 4: Adding a Discrimination Procedure

Similarly to the previous step, select the **Method** event,
add a new **group** event, and change its title and
category to *Vertical/Horizontal Discrimination* and
Procedure.
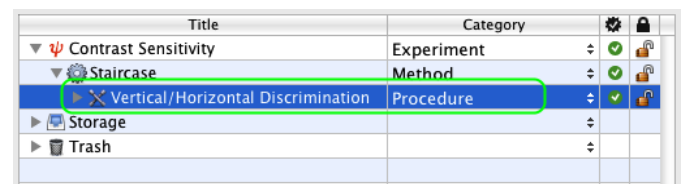
Step 5: Adding a Gabor Stimulus

Now, select the **Procedure** event, and add a new **leaf** event by clicking on the file icon with the '**+**' symbol in the bottom toolbar. Change its title and category to *Gabor Stimulus* and **Visual Stimulus** as illustrated.

Tip: *As atomic events, leaf events do not embed other events hence the absence of the small arrow in front of their descriptive mini-icon.*

We have completed the basic hierarchical structure of the experiment, so let's move on to the customization of each event.
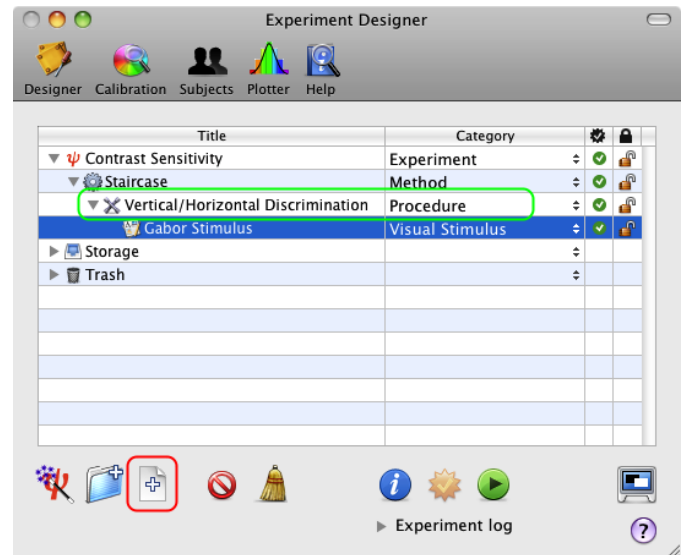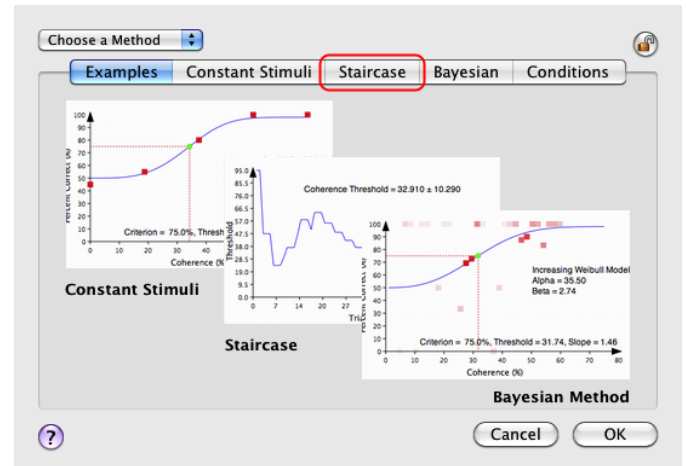
Step 6: Customizing the Method

Click on the *Staircase* event to select it, and click on the **Inspector** button (or press the **Apple-i** keystroke) to inspect the properties of the **Method**.
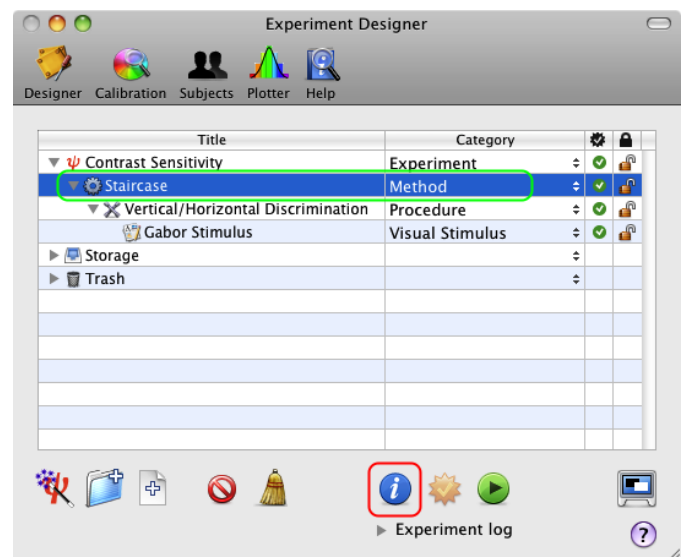
A properties page for the **Method** event appears with the **Examples** tab selected by default. Click on the **Staircase** tab to select the Staircase Method and view/edit its properties.

The default settings are suitable for a standard staircase method but should be customized to better fit your experimental requirements. The mandatory changes are those associated with the stimulus parameter that drives the threshold estimation during the experiment, as illustrated below with the **Gabor contrast** which is the **dependent variable** of this experimental design.
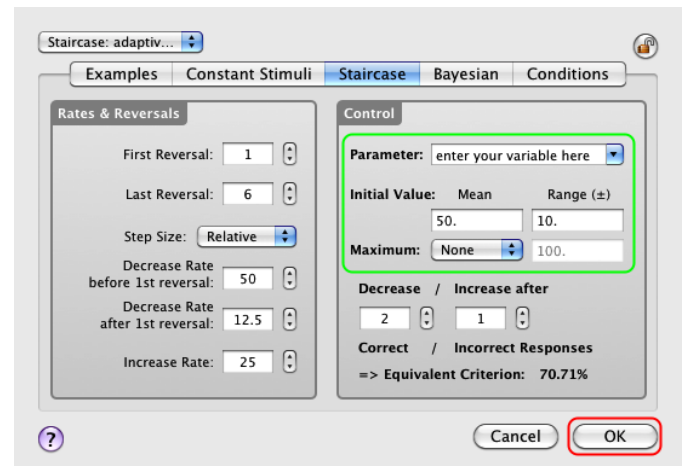
The name of the stimulus parameter and its initial value (in the range specified by a uniform distribution, mean ± deviation) need to be set appropriately. Change these values to match those of the figure: the parameter is named "**contrast**" and its initial value is set in the range *90 ± 10* (in %). You can also specify optionally a maximum value for the contrast (eg: 100%).
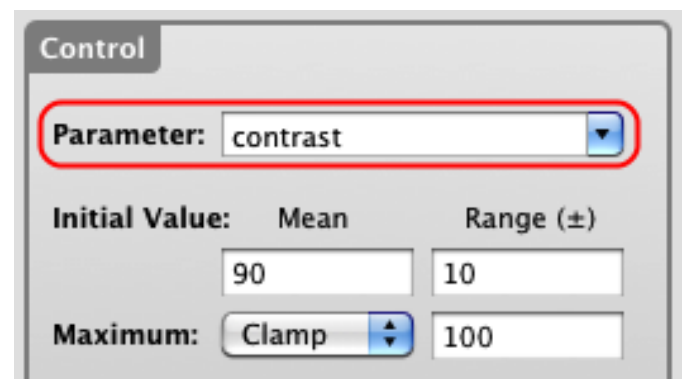
Click on the **OK** button on the properties page to validate these changes and return to the **Designer** panel.

Step 7: Customizing the Procedure

Once you have returned to the **Designer** panel, select the *Vertical/Horizontal Discrimination* **Procedure** event, and click on the **Inspector** button to inspect its properties.
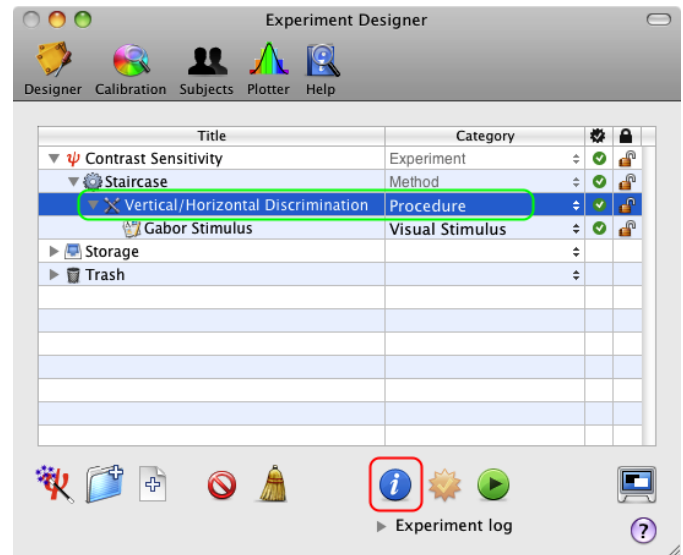
The properties page for the **Procedure** event consists of three sections:

1) A right side common to all procedures that specifies the properties to be applied to each trial

2) A top-left section that specifies the type of procedure **Examples** tab selected by default) and its properties

3) A bottom-left section that provides more customization for some of the procedures (reaction times and pedestal)
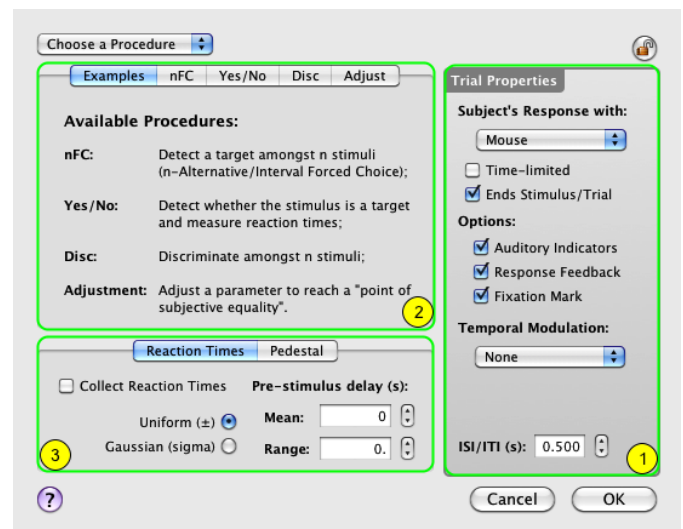
Let's customize each of these sections:

1) First, in **Trial Properties** change the type of inputs used by the subject to provide his/her responses: select the **Keyboard** device instead of the default (**Mouse**). The top/down arrows will be used by the subject to indicate a vertical stimulus, while the left/right arrows will indicate a horizontal stimulus.
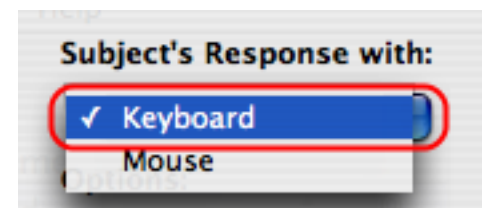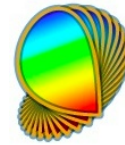
Uncheck the **Fixation Mark** option, so no fixation is displayed during the stimulus presentation (pre- and post-stimulus fixations may be still present). This minimizes the possibility of interference between a low contrast stimulus and the fixation.
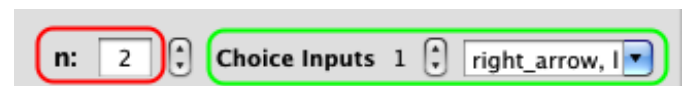
2) In the procedure-specific section of the panel, click on the **Disc** tab to select the discrimination procedure and view/edit its settings.
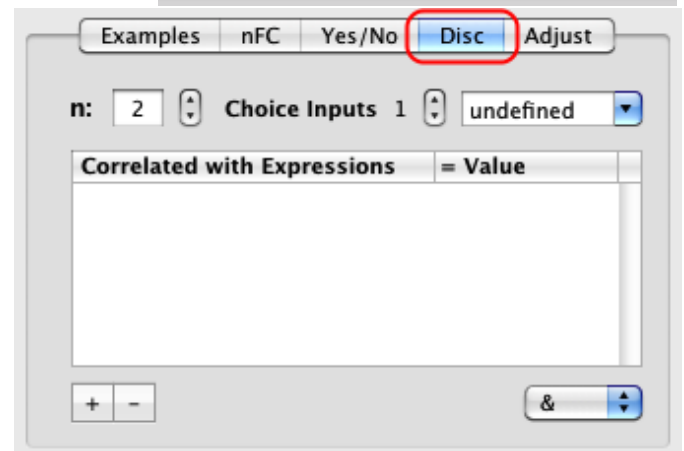

Make sure a 2AFC discrimination is specified by setting **n** to *2*; **n** also corresponds to the number of inputs as there is one input for each alternative decision (vertical or horizontal) in the **Discrimination Procedure**.

Enter the subject response associated with each alternative decision: select the first choice index with the stepper (1 in the above figure) and enter the keyboard keys (*right_arrow, left_arrow* in the figure) corresponding to the horizontal decision, followed by **RETURN**.

Tip: *Several inputs, separated by a comma, can be specified for the same decision.*

Similarly, set the *up_arrow, down_arrow* response keys for the second choice index corresponding to the vertical decision, followed by **RETURN**.
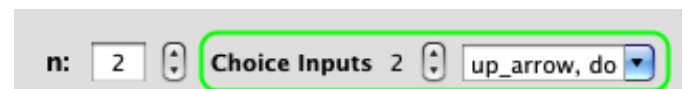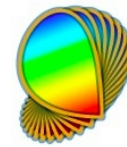
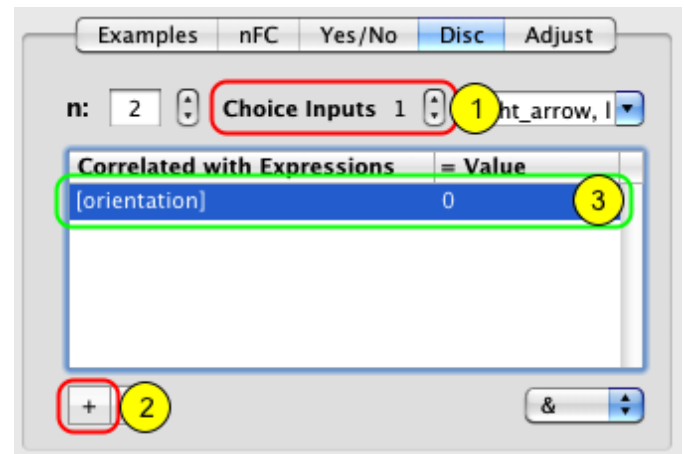Now let's indicate explicitly the relationship between the decision and the random variable that controls the stimulus orientation. The subject is expected to provide a correct response when pressing the right or the left arrows for a horizontal stimulus (orientation of 0 deg).

To specify this:

1) select the choice input 1
2) click on the '**+**' button to add an expression entry in the table
3) in the "**Correlated with Expression**" column enter the name of the **Orientation** variable between brackets, and its expected value in the "**= Value**" column (0 deg)

Similarly, the subject is expected to provide a correct response when pressing the up or the down arrows for a vertical stimulus (orientation of 90 deg):

1) select the choice input 2
2) click on the '**+**' button to add an expression entry in the table
3) in the "**Correlated with Expression**" column enter the name of the **Orientation** variable between brackets, and its expected value in the "**= Value**" column (90 deg)
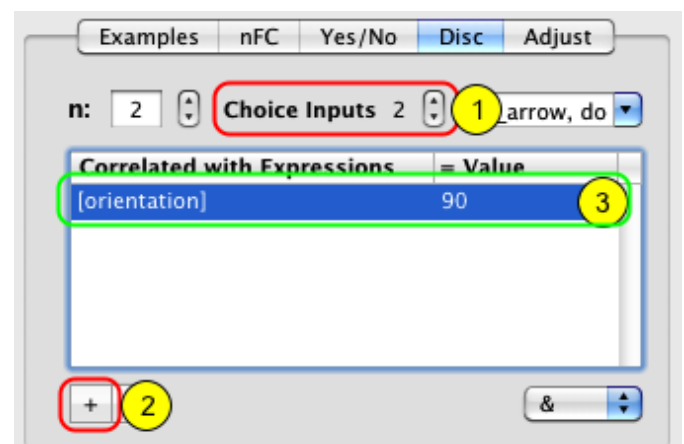
Click on the **OK** button to validate the changes and return to the **Designer** panel.

Step 8: Customizing the Visual Stimulus

From the **Designer** panel, select the *Gabor* **Visual Stimulus** event, and click on the **Inspector** button to inspect its properties. On the properties page, click on the **Grating** tab to select the Grating-like Stimulus and view/edit its settings.
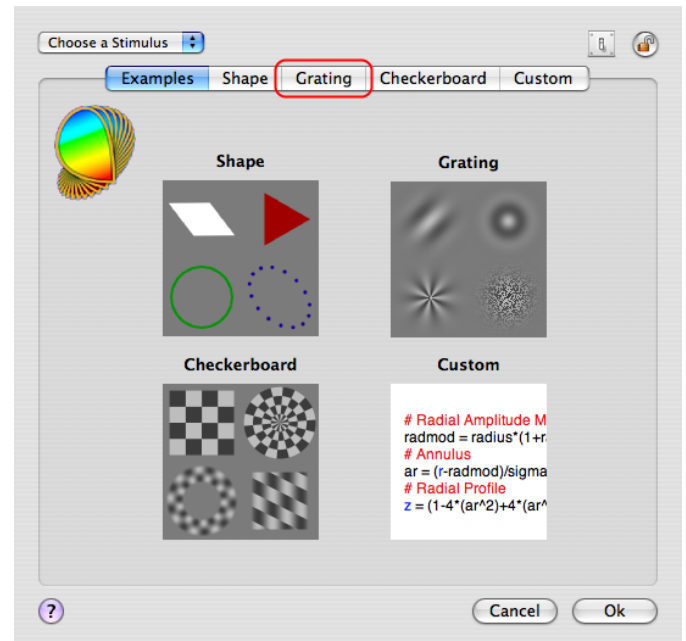
The properties page for the **Visual Stimulus** event consists of four sections:

1) A top section common to all types of visual stimulus that specifies their position, duration, and appearance

2) A middle section that specifies the carrier properties

3) A bottom-left section that specifies the envelope properties

4) A real-time preview in the bottom right-hand corner that can be zoomed in and out
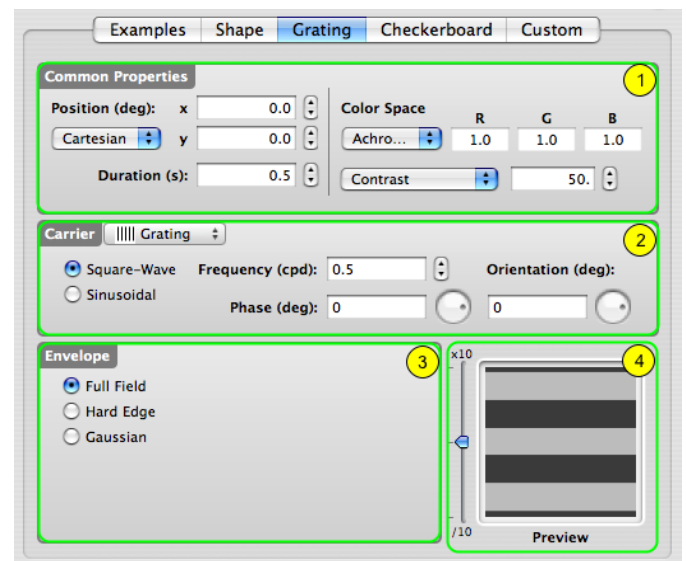
Let's customize each of these sections:
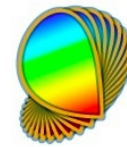
1) Connect the **Stimulus Contrast** to the parameter used by the **Staircase Method** by selecting the *contrast* variable that appears in the contextual menu when control-clicking on the text field, as illustrated above. Make sure to select the entire content of the text field before selecting the variable in the menu so the selection completely replaces the previous content.
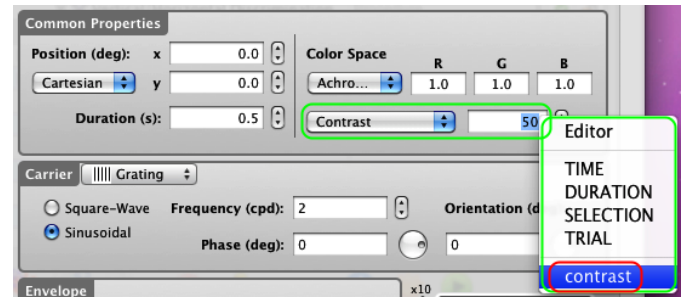
Note that once selected, the variable name appears in brackets, thus indicating that the variable is providing a value to the stimulus parameter. Note as well that the stimulus preview became blank. This is because its contrast is assigned to the variable *contrast* whose value will be specified by the staircase method when running the experiment. The default value for any variable is 0.
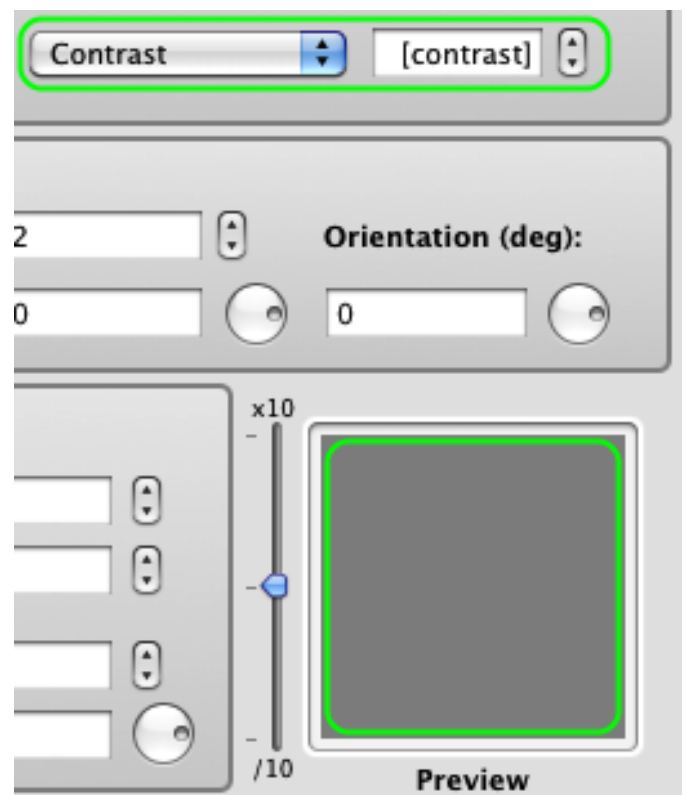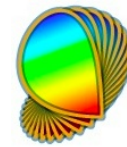
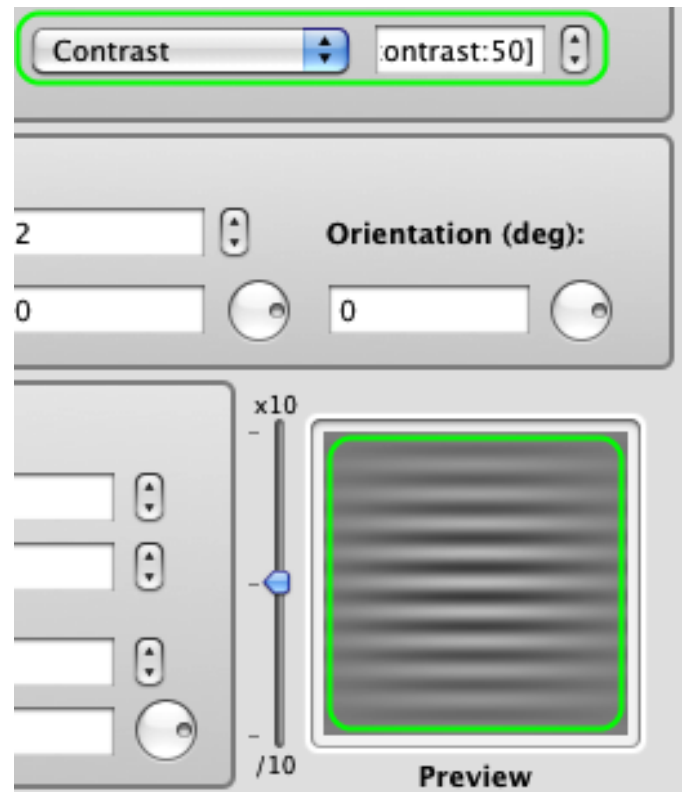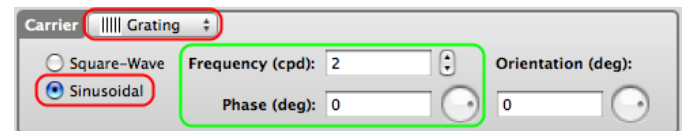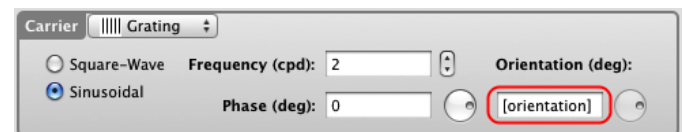To display a preview for a variable value other than the default, add the desired value preceded by a colon before the closing bracket (eg: [contrast:50]). This value is now used but only for preview purposes and has no effect on the experimental design.

2) To create the Gabor stimulus: select the **Grating** type from the Carrier pop-up menu in the middle section; select **Sinusoidal** modulation; and set the values for the spatial frequency and phase.

Most importantly, connect the **Carrier Orientation** to the parameter used by the **Discrimination Procedure** by entering the *orientation* variable in brackets.

Note: the orientation variable does not appear in the contextual menu when control-clicking on the orientation text field because it has not been declared yet (see step 9 below).

To display a preview for a value of the carrier orientation other than the default (0), add the desired value preceded by a colon before the closing bracket (eg: [orientation:90]). This value is used only for preview purposes and has no effect on the experimental design.

3) In the bottom-left section, select a **Gaussian** envelope and set the value for its sigma. Select the circular shape with an aspect-ratio of 1.

4) Note how the preview is automatically updated with your changes (use the slider to zoom the preview in and out).
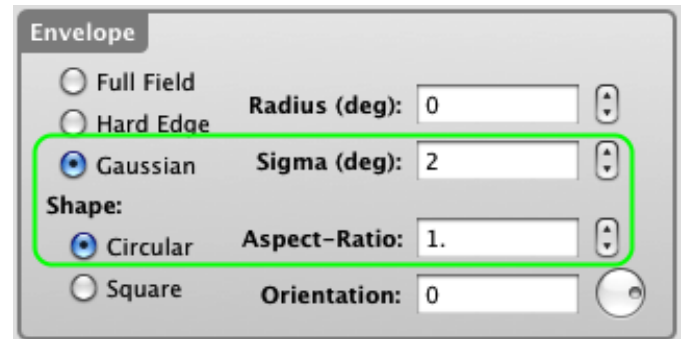
We have finished with the experimental design so click on the **OK** button to validate the changes and return to the **Designer** panel.

Step 9: Customizing the Experiment

We have almost completed the experiment design. Two things remain to be done:

1) To specify the possible values taken by the orientation variable (so far we have just specify its expected values relative to the subject's discrimination task).

2) To take advantage of the bit-stealing technique to improve the measurement of the contrast thresholds.

Both can be done by customizing the Experiment properties. From the **Designer** panel, select the *Contrast Sensitivity* **Experiment** event, and click on the **Inspector** button to inspect its properties.

1) On the properties page, click on the **Control Settings** tab to view/edit the control settings, ie. those settings that affect the experimental protocol.

2) Click on the '**+**' button to add an entry in the **Independent Variables** table.

3) Edit this entry and name its parameter ***orientation*** and specify its possible values separated by a comma: **0** and **90**. Each time this variable will be used to define the stimulus orientation, its value will be randomly chosen among these 2 values.
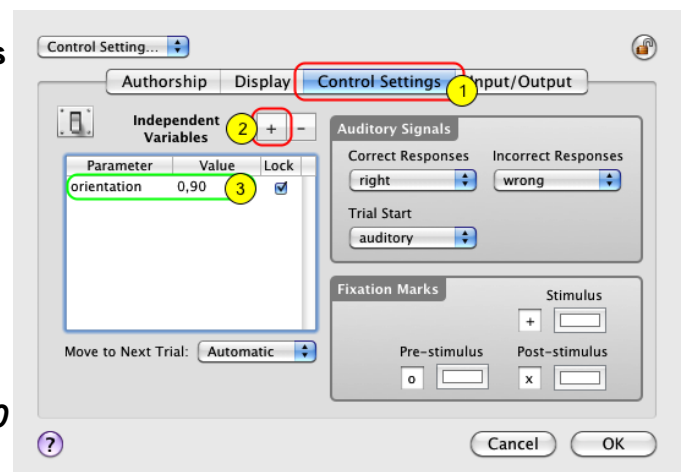
4) Click on the **Display** tab to view/edit the display settings, ie. those settings that affect the stimuli rendering on the experimental display.

5) Select the **Mono 10.8 bits Bit-Stealing** option in the **Chromatic Mode** pop-up menu. This indicates the use of the bit-stealing technique to improve the contrast resolution from 256 (8-bits) to 1786 (10.8-bits) gray levels (see the **Defaults Preferences** section of the documentation to learn more about it).
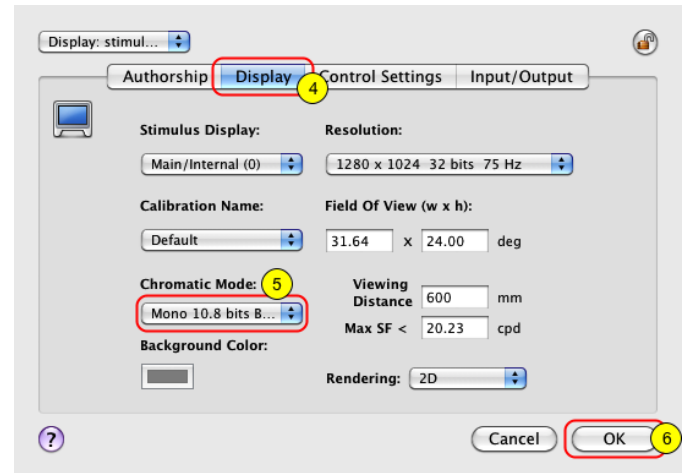
6) Click on the **OK** button to validate these changes and return to the **Designer** panel.

Step 10: Checking & Running the Experiment

To run an experiment, simply do the following:

1) Select the *Contrast Sensitivity* **Experiment** event which is at the root of your experiment design.

2) Check the validity of your design by clicking on the **Check** button in the button toolbar: if correct, all the indicators in the check column turn into green check marks.

3) Toggle the experimental session between windowed or full-screen mode: *the windowed mode is appropriate for testing purposes only as neither Gamma correction nor timing checks are performed during the experiment, and the session results are not saved into Psykinematix database.*

4) Click on the **Run** button to run the experiment.
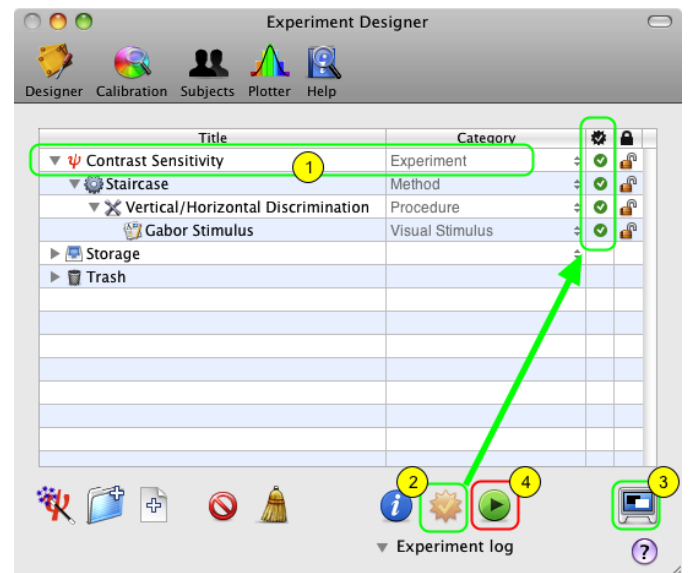
Tips:
*Experiments can also be run through the **Experiments** menu which contains an up-to-date list of all the experiments present in the **Designer** panel.*
*If the **Check** button is disabled, Auto-Checking is activated so an event status is automatically updated every time the event is modified (see related option in the Preferences panel).*

This warning message is displayed when no calibration configuration is specified for the experiment running (see the end of the **Calibration Tutorial** to learn how to specify a calibration configuration); however, you can still run the experiment using a default calibration by clicking on the **Continue** button.
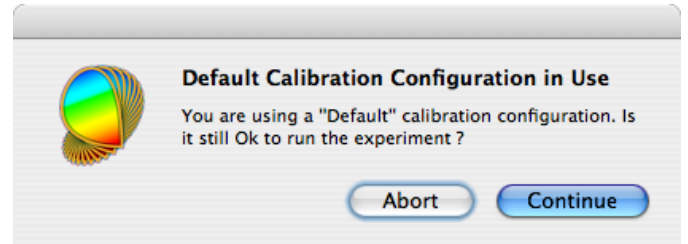
Before the session starts in full-screen mode, a panel summarizing the **Session Information** is displayed. You can either run the session in testing mode, which does not require the specification of the subject and group, or in real mode, if you specify them. ***In testing mode, no session data is actually saved in the results database***.
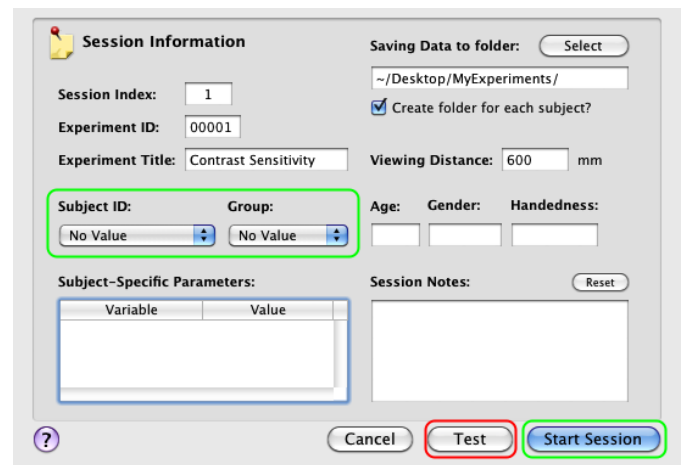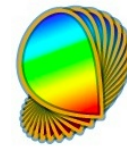
If you have already entered subjects and groups in the **Subjects** panel (see the **Subjects Tutorial**), you can select them using the two pop-up menus provided. Their age, gender, and handedness are then shown.
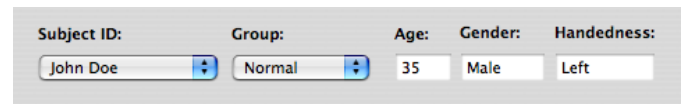
Click on the **Start Session** button.

Press **ESC** (escape keyboard key) to stop the session at any time.

Step 11: Visualizing the Results

Once the session has completed normally, you are asked to press **ESC** to return to the **Designer** panel. If an error occurred during the session, a logging panel will automatically show up with relevant error and warning messages. This panel also includes a summary of the experimental conditions in terms of subject, display setup, and various other diagnostic information. If no error occurred, you can still reveal this panel by clicking on the small arrow **Experiment log**.
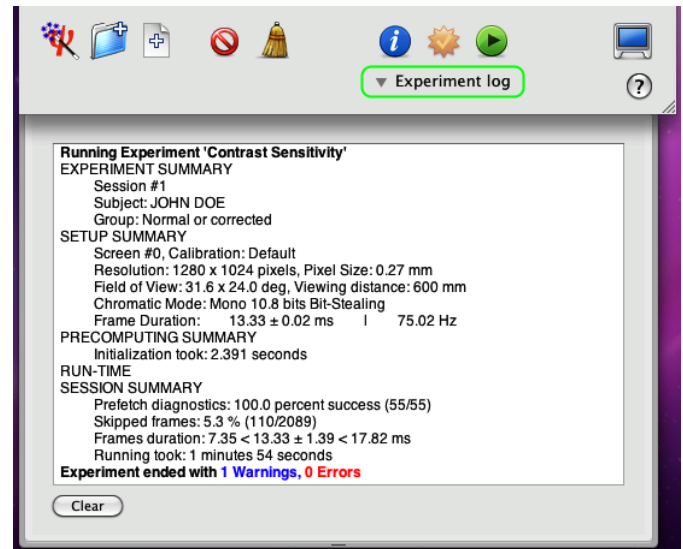
Upon termination of an experimental session, results data are created and saved in the Psykinematix database. The session data can also be visualized immediately on the **Plotter** panel:

1) Click on the **Plotter** icon in the toolbar to access the panel.

2) Option-click on the small arrow in front of the session entry to expand the whole hierarchy of the results data.
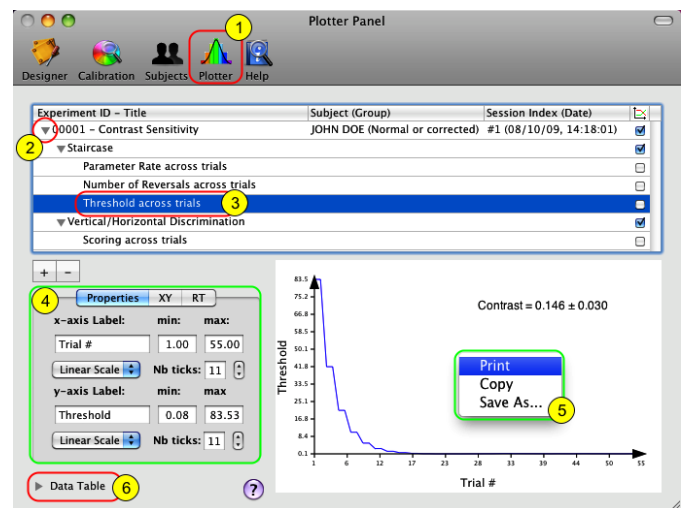
3) Select one of the entries in the final level of the hierarchy to plot its attached dataset (each entry contains a different dataset).

4) You can customize the appearance of the graph using the "Properties" tab.

5) Control-click inside the graph to print, copy, or save it to a file.
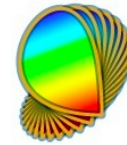
6) Click on the arrow to reveal the spreadsheet containing the selected data used to plot the graph (control-click inside the spreadsheet to print or export the data).

Trial Index	Response	Input	Choice Index	Stimulus orientation	RT	Scoring (%)
1	Hit	Up Arrow	2	90	NA	100
2	Hit	Right Arrow	1	0	NA	100
3	Hit	Right Arrow	Print	0	NA	100
4	Hit	Up Arrow	Open in... ▶ Excel			100
5	Hit	Up Arrow	Export as File Numbers			100
6	Hit	Up Arrow				100
7	Hit	Up Arrow	2	90	NA	100
8	Hit	Up Arrow	2	90	NA	100

See the **Subjects Tutorial** and the **Plotter Tutorial** to learn how to select, import, and plot data collected during previous Psykinematix sessions.

Conclusion

In this lesson, you learned the Psykinematix basics: how to create the hierarchical structure of an experiment, how to customize the events, how to use variables to connect procedural and stimulus events, and how to run a session and inspect the results.

In the next lesson, you will learn how to interleave several staircases to investigate the effect of spatial frequency on contrast thresholds (**Lesson 2**). You may also consider the following lessons of the **Orientation Discrimination** tutorial to learn how to:

- implement a sandwich paradigm with forward and feedback masking noise (**Lesson 3**),
- add a spatial and temporal context (**Lesson 4**),
- add motion & dynamics through the use of a 1st-order drifting Gabor (**Lesson 5**).