Contrast Sensitivity: Lesson 2

In this lesson, you will learn how to:

- duplicate an experiment,
- set experimental conditions through the **Conditions** method,
- move the events using drag and drop.

This lesson assumes you have been through Lesson 1 of this tutorial and become familiar with adding and inspecting the various types of events.

EFFECT OF SPATIAL FREQUENCY

In Lesson 1, you learned how to create a basic experiment to measure contrast threshold for a single spatial frequency. This lesson makes the **basic contrast sensitivity task** more elaborate by measuring the effect of the Gabor stimuli's spatial frequency. The measurements will be made through interleaved staircase methods, each of them specifying one experimental condition (spatial frequency).

Step 1: Duplicating the Experiment

From the **Designer** panel, select the **Contrast Sensitivity** experiment designed in Lesson 1, and press the **Apple-D** keystroke (or select **Duplicate** from the **Edit** menu). The duplicate appears at the top level of the table with the 'copy' suffix added to the name of the original event. Rename the copy as **Contrast Sensitivity 2**.

Tip: There are alternative ways to duplicate an event:
*- Using the regular Copy/Paste with the **Apple-C** & **Apple-V** keystrokes; events copied this way are always pasted in the **Storage** area of the table.*
- Option-drag an event to make a copy at the dragged position.
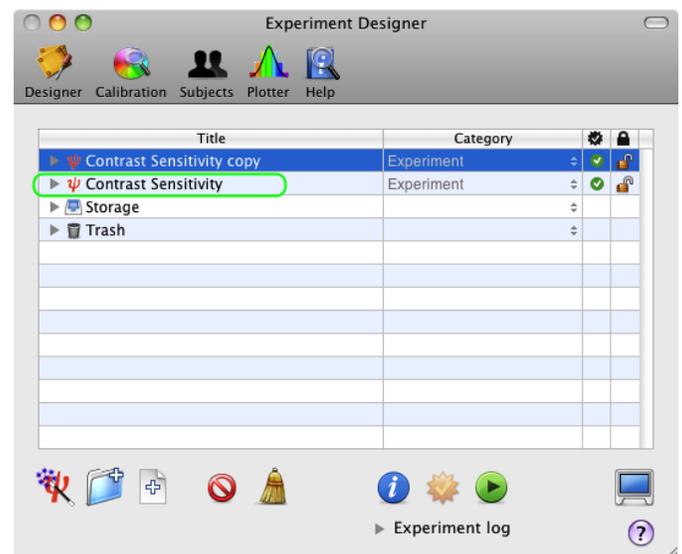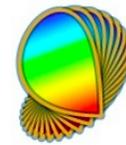
## Step 2: Adding and Customizing a "Conditions" Event

Select the **Contrast Sensitivity 2** experiment, reveal its hierarchy, and insert a new group event using the '**+**' folder icon. Set the name and category of this new event to **Conditions** and **Method**, respectively.

Select the new event named **Conditions**, and click on the **Inspector** button to inspect and modify its properties:
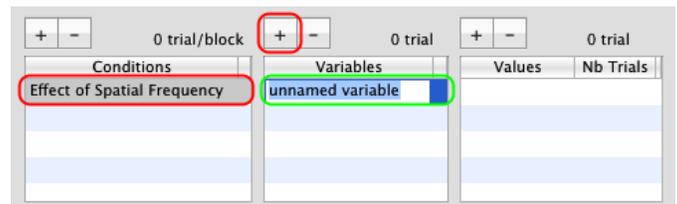
1) Click on the **Conditions** tab to select the conditions builder.

2) Click on the '**+**' button to add a new condition (called **unnamed condition** by default).
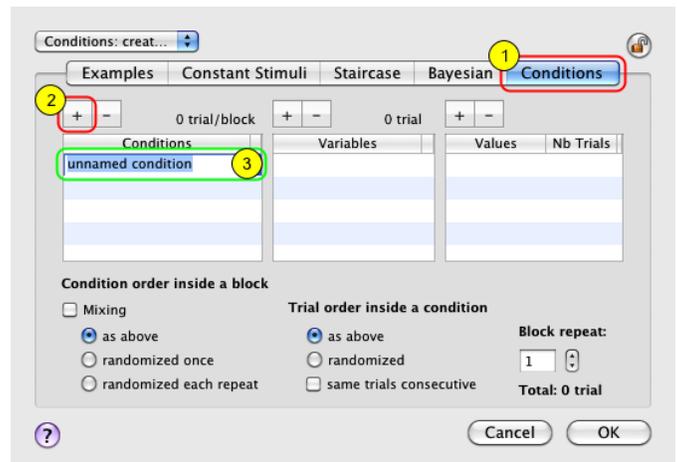
3) Rename it as **Effect of Spatial Frequency**.

Make sure to select this new condition, and click on the **+**' button to add a new variable (called **unnamed variable** by default). Rename this variable as **sf** (for spatial frequency).

Make sure to select this new variable, and click on the '**+**' button to add a new value (called **unnamed value** by default). Set this value to **0.5**. Leave the number of trials as **1**.
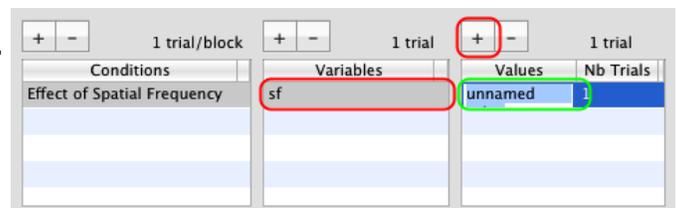
Add additional values for the **sf** variable, for example: **1**, **2**, **4**, **8**, and **16** (spatial frequency expressed in cycle per degree).
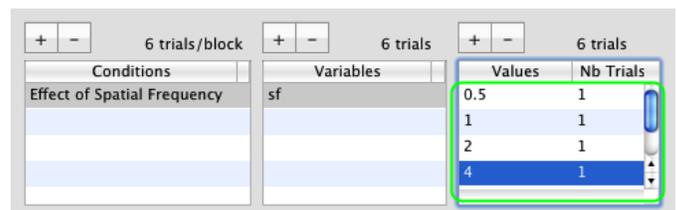
You have defined six experimental conditions: the *sf* variable is the **independent variable** of this experimental design which will take one of the six values in each trial. The number of trials for each value was left as 1 because the actual number is unknown since it will depend on how fast the adaptive method (staircase) can estimate the threshold.

Finally, make sure to indicate that the trials order should be randomized.

Click on the **OK** button to validate the changes and return to the **Designer** panel.

## Step 3: Updating the Hierarchy and the Stimulus Properties

Click on and drag the *Staircase* event *INTO* the *Conditions* event so it is indented as illustrated. This way a staircase will run for each experimental condition defined above, and the different staircases will be presented interleaved.
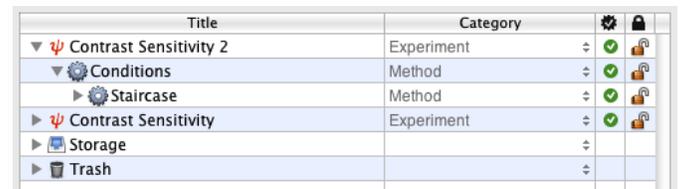
Option-click on the arrow in front of the *Staircase* event to reveal the entire hierarchy down to the *Gabor Stimulus* event.

Select the *Gabor* event and edit its properties by clicking on the **Inspect** button (or press **Apple-i**).
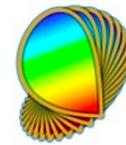
Finally, connect the *sf* variable, defined in the **Conditions** event, to the spatial frequency parameter of the stimulus (select and control-click on the text field content and choose the appropriate variable in the contextual menu). Note that the *orientation* variable has been already connected to the stimulus orientation in Lesson 1.

If you wish to preview the stimulus with a realistic value for its *sf* parameter (it is set to 0 by default), just add a colon (:) after the variable name followed by a value, all between brackets as illustrated. This will not affect the normal operation of the experiment in any way.
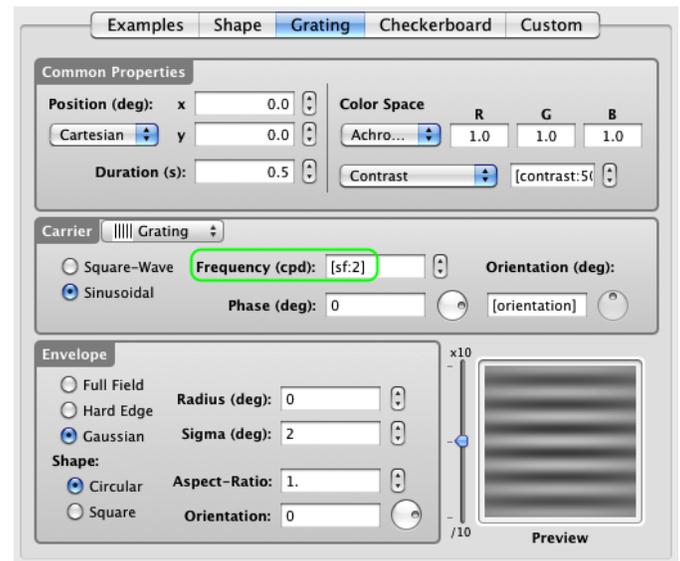
Click on the **OK** button to validate the changes and return to the **Designer** panel.

Check & run the Experiment!

Important note: To save the session results in the results database for future retrieval, always make sure to:

- run the experiment in full-screen mode by toggling the display icon in the **Designer** bottom toolbar,
- select the subject and group in the **Session Information** panel,
- click on the **Run Session** button in the **Session Information** panel.
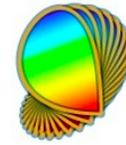
Step 4: Visualizing the Results Summary

Upon termination of an experimental session, results data can be visualized immediately on the **Plotter** panel. Click on the **Plotter** icon in the toolbar to access this panel. The results for the last session appear at the bottom of the table.

As noted above the results are saved in the Psykinematix database only if the session was run in real mode. In this example, the **Subject (Group)** column shows **Testing Mode (None)** which indicates that the session has not been run in real mode and that its results will not be saved in the database after quitting Psykinematix.
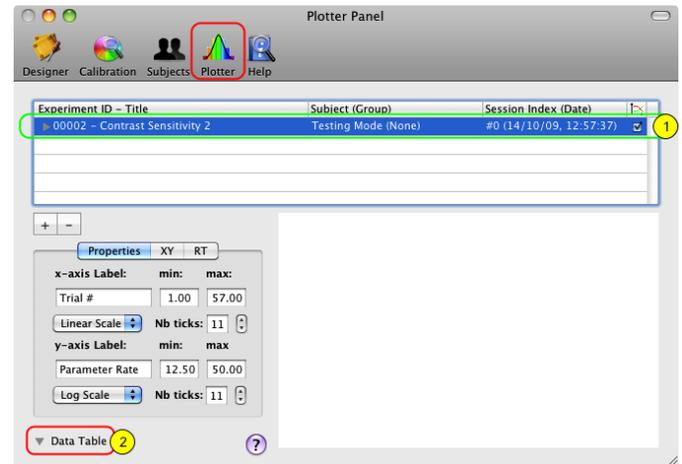
To visualize a summary of the results:

1) Select the session,

2) Click on the arrow to reveal the spreadsheet containing the results summary.

This table contains a single dataset named **Contrast**. This dataset presents the contrast threshold measured by the staircase method for each experimental condition. Each line refers to a condition, and each column presents the values for each relevant information:

- **Condition**: the name of the condition. Here a single condition was declared in the **Conditions** event (see Step 2 above).

- **Mean** and **Std**: the mean and standard deviation for the threshold measured by the staircase. The unit is the same as for the initial contrast value indicated in the **Staircase** event (see Step 6 in Lesson 1).
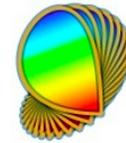
- **Variables**: the independent variables associated with the condition and their values. Several variables could be indicated in this column (see for example Lesson 2 of the **Orientation Discrimination** tutorial).

Control-click inside the spreadsheet to print or export this summary data.

For example, you could export the data directly to Excel to create a graphical representation of the contrast sensitivity (reciprocal of the contrast threshold as function of the spatial frequency). The above plot was obtained with the data collected in less than 10 minutes from a single session of this lesson.
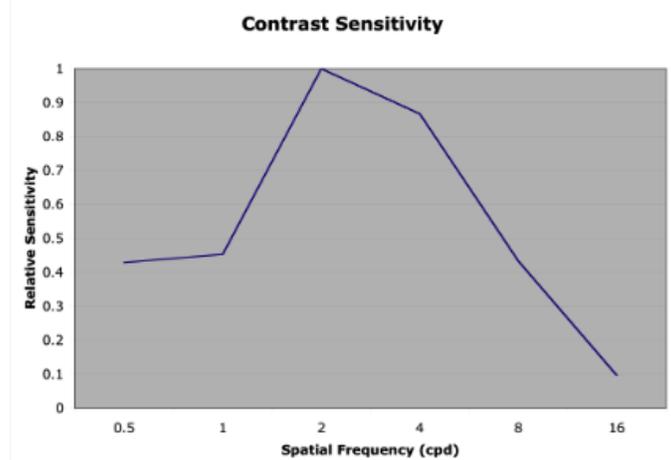
Generally, there is no need to inspect further the results produced during the session. However, in case of doubts regarding the data reliability it is possible to review the dataset for each experimental condition as illustrated in the next step.

Contrast Sensitivity

Step 5: Inspecting the Results for each Condition

1) Click on the small arrow in front of the session entry to expand its second hierarchy level. You are presented with the method and procedure components of the results for each experimental condition: the first column indicates which method or procedure event produced the dataset, the second column indicates the condition, and the third column indicates the values of the independent parameters for this condition.

Experiment ID – Title	Subject (Group)	Session Index (Date)	
00002 – Contrast Sensitivity 2	Testing Mode (None)	#0 (14/10/09, 12:57:37)	☑
▶ Staircase	Condition: Effect of Spatial	sf = 0.5	☑
▶ Staircase	Condition: Effect of Spatial	sf = 2	☑
▶ Staircase	Condition: Effect of Spatial	sf = 16	☑
▶ Staircase	Condition: Effect of Spatial	sf = 4	☑
▶ Staircase	Condition: Effect of Spatial	sf = 8	☑
▶ Staircase	Condition: Effect of Spatial	sf = 1	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 0.5	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 2	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 16	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 4	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 8	☑
▶ Vertical/Horizontal Discrimination	Condition: Effect of Spatial	sf = 1	☑

Selecting any **Staircase** entry updates the spreadsheet (revealed by clicking on the "Data Table" arrow) with the method parameters or variables for each trial run for the condition: the trial index, the number of reversals, the parameter rate and the value of the dependent variable (contrast **Threshold**).

| Trial Index	Number of Reversals	Parameter Rate	Threshold
1	0	50	90.62268
2	0	50	90.62268
3	0	50	45.31134
4	0	50	45.31134
5	0	50	22.65567
6	0	50	22.65567
7	0	50	11.32784
8	0	50	11.32784
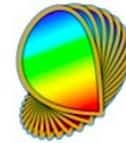
2) Click on the small arrow in front of the **_Staircase_** entry to expand the third hierarchy level. You are presented with the individual parameters or variables for the method. Select one of these entries to graph its attached dataset and update the spreadsheet with the trial history for the selected parameter or variable.
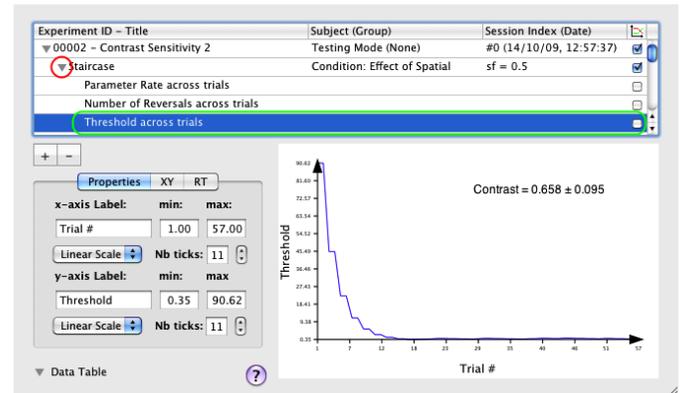
3) You can customize the appearance of the graph using the "Properties" tab. Control-click inside the graph to print, copy, or save it to a file.

See the "**Import, Plot, Fit, and Export Data**" tutorial to learn more about the Plotter panel.
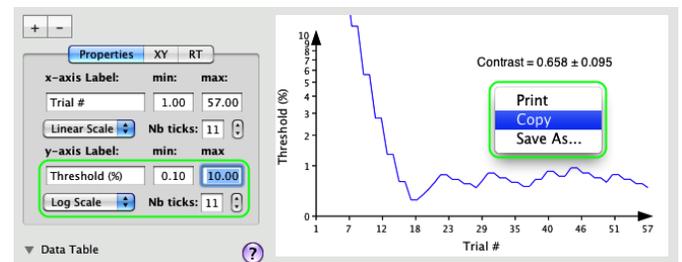
Conclusion

In this lesson, you learned how to duplicate an experiment, specify experimental conditions through a **Conditions** method, and move the events using drag and drop. You also learned how to inspect each level of the results hierarchy. Most important, you learned in Lessons 1 and 2 how to create a complete experiment to measure contrast sensitivity, one of the most fundamental properties of the visual system.

If you wish to expand this experiment by adding temporal masking or spatial context to the stimulus, or by using dynamic stimuli, you should 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**).