FEAT 1 Practical FEAT 1 实操

This tutorial leads you through a standard single-subject analysis with FEAT. There may be moments when you are waiting for programs to run; during those times take a look at the FEAT manual (in particular go to the User Guide and look at the FEAT in Detail section). We also suggest that you do read it carefully after the course, before using FEAT for analysing your own data.

本教程将引导您完成 FEAT 的标准单被试分析。你有时可能需要等待程序运行。在这段时间里，请查看 FEAT 手册（特别是转到 User Guide，然后查看 Detail 部分）。我们还建议您在使用 FEAT 分析自己的数据之前，在学习课程后仔细阅读该手册。

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  Perform a full first-level analysis of a single subject in an event-related language experiment.

- **Featquery**

  Use featquery to interrogate results of the previous analysis and extract ROI measurements.

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- **真实 fmri-fluency 数据集示例**

  在一个事件相关的语言实验中对单被试进行完整的初级分析。

- **Featquery**

  使用 featquery 询问先前分析的结果并提取 ROI 测量值。

Example real fmri-fluency dataset

真实 fmri-fluency 数据集示例

```
cd ~/fsl_course_data/fmri1/fluency_task
```

The dataset fmri.nii.gz is from a language experiment. The TR is 4.2 seconds. The experiment is event-related and has three different types of events:

数据集 fmri.nii.gz 来自一个语言实验。TR 为 4.2 秒。该实验采用事件相关设计，并且有三种不同类型的事件：

1. **Word-generation events (WG):** Here the subject is presented with a noun, say for example "car" and his/her task is to come up with a pertinent verb (for example "drive") and then "think that word in his/her head". The subject was explicitly instructed never to say or even mouth a word to prevent movement artefacts.

2. **Word-shadowing events (WS):** Here the subject is presented with a verb and is instructed to simply "think that word in his/her head".

3. **Null-events (N):** These are events where nothing happens, i.e. the cross-hair remains on the screen and no word is presented. The purpose of these "events" is to supply a baseline against which the other two event types can be compared.

Note that there were no additional "instruction events" as part of the experiment. Each event was "its own instruction" in that the class of the word determines the task. This means that even the "shallow" word-shadowing events contain an element of grammatical decoding.

1. **Word-generation events（WG）**：在该事件中，向被试展示一个名词，比如说“汽车”，而他/她的任务是由此生成一个相关的动词（例如“drive”），然后“在他/她的脑海里想着这个词”。 明确指示该被试从不说一个字以防止运动伪影。

2. **Word-shadowing events（WS）**：在该事件中，向被试显示一个动词，并指示其简单地“在他/她的脑海中想着该词”。

3. **Null-events（N）**：在该事件中，什么都没有发生，即，只在屏幕上呈现十字注视点而不显示任何单词。这些“事件”的目的是为比较其他两种事件类型提供基线。

请注意，实验中没有其他“指令事件”。每个事件都是“自己的指令”，因为单词的类别决定了任务。这意味着，即使“隐形”的 word-shadowing events 也包含语法解码元素。

Within one session, the events were presented at a constant ISI (Inter Stimulus Interval) of 6 seconds. For example, the first 72 seconds (twelve events) in this session may have looked like:

在一个 session 中，事件以恒定的 6 秒 ISI（刺激间隔）呈现。例如，此会话中的前 72 秒（十二个事件）可能看起来像：

```
N-WS-N-WS-N-WS-N-WG-N-WS-WG-N
```

The randomisation of event types was "restricted" in the sense that there was an equal number (24) of each event type. In other words, at any given ISI each type of event was equally likely.

事件类型的随机化是“受限的”，要确保每种事件类型的数目相等（24）。换句话说，在任何给定的 ISI 中，每种类型事件的出现均具有相同的可能性。

The main question for this experiment was to see if the "deeper" language processing in the word-generation task would yield activations over and above that of the shallower processing in the word-shadowing task. But there are also other interesting questions you can ask of the data. So, let us get started with the analysis.

此实验的主要问题是查看单词生成任务中的“较深层次”语言处理是否会产生比单词隐藏任务中较浅的处理更高的激活。但是您还可以对数据提出其他有趣的问题。因此，让我们开始进行分析。

```
Feat &
```

(Type `Feat_gui &` if you are on a Mac).

（Mac 上则输入 Feat_gui &）

Data

Feat starts by displaying the **Data** tab. Press **Select 4D data** and select **fmri.nii.gz** (don't just type "fmri.nii.gz" in the file select popup or you probably won't end up setting the full pathname; use the file-select icon on the right to select the input data).

FEAT now knows how many time points (volumes) you have (106 in this dataset). The GUI will set the TR (time between 3D volumes) using information in the NIFTI file, however this information is not always correct (depending on how the conversion to NIFTI was done). So you should always check that the value for TR is correct after the FMRI data is loaded. For these data it should be 4.2 seconds (you might get 4.199, and that is ok).

数据

壮举开始于显示 Data 选项卡。点击 Select 4D data，然后选择 fmri.nii.gz（不要仅在文件选择弹出窗口中键入“fmri.nii.gz”，否则您可能最终不会设置完整路径名；请使用右侧的 file-select 图标来选择输入数据）。

FEAT 现在知道您有多少个时间点（体积）（此数据集中为 106）。GUI 将使用 NIFTI 文件中的信息来设置 TR（3D 体积之间的时间），但是该信息并不总是正确的（取决于转换为 NIFTI 的方式）。因此，加载 FMRI 数据后，您应始终检查 TR 的值是否正确。对于这些数据，应该为 4.2 秒（您可能会得到 4.199，这没关系）。

The **High pass filter cutoff** is preset to **100secs**. This is chosen to remove the worst of the low frequency trends, and is also long enough to avoid removing the signal of interest. In general you need to ensure that this is not set lower than your maximum stimulation period. For a random-order event-related design there is no clear "stimulation period" so in order to assess what the cutoff should be one needs to analyse the frequency-content of our expected activations (remember that the design matrix embodies what we expect to see in the brain). Leave it at the default for now and we'll come back to it when we have specified the design.

High pass filter cutoff 预设为 100 秒。选择此项可以消除最坏的低频趋势，并且其长度还足以避免除去感兴趣的信号。通常，您需要确保将其不低于于最大刺激期。对于随机事件相关的设计，没有明确的“刺激期”，因此为了评估临界值，需要分析预期激活的频率含量（请记住，设计矩阵体现了我们期望在大脑中看到的结果）。现在将其保留为默认值，指定设计后我们将重新设置它。

Pre-stats and Stats

Press the **Pre-stats** tab to look at the preprocessing steps. For this experiment we will change **Spatial smoothing FWHM (mm)** to 7mm, which is slightly more than we normally recommend. All the other default pre-processing steps are fine for this dataset.

预统计和统计

按下 Pre-stats 选项卡以查看预处理步骤。对于本实验，我们将 Spatial smoothing FWHM (mm) 更改为 7mm，这比我们通常建议的略大。对于此数据集，其他预处理步骤设置保留为默认值即可。

Setting up the design matrix

Select the **Stats** tab and press **Full model setup** to setup the GLM details.

Change the **Number of EVs** to **2** (we have two conditions to model separately - Word-generation and Word-shadowing).

设置设计矩阵

选择 Stats 选项卡，然后点击 Full model setup 来设置 GLM 详细信息。

将 Number of EVs 更改为 2（我们有两个要分别建模的条件- Word-generation 和 Word-shadowing）。

Setup **EV1** (Word-generation): First chose a sensible name like for example **Gen** for it and change **Basic shape** to **Custom (3 column format)** and select the file word_generation.txt. Later (when you wait for FEAT to finish the analysis) we will return to this file and make sure you understand what is in it. Next set **Convolution** to *Double-Gamma HRF* which corresponds to the HRF you saw in the talks. Leave the setting for **Phase**, to the default but *unset* **Add temporal derivative**. We would normally recommend leaving it set (and we will come back to set it) but in order to obtain a very simple initial design we will unset it for now.

设置 EV1 (Word-generation)：首先为其选择一个明智的名称，例如 Gen，然后将 Basic shape 更改为 Custom（3 列格式），然后选择文件 word_generation.txt。 稍后（当您等待 FEAT 完成分析时），我们将返回此文件并确保您了解其中的内容。接下来，将 Convolution 设置为 Double-Gamma HRF，它与您在课堂中中看到的 HRF 相对应。 将 Phase 设置保留为默认设置，但**取消设置** Add temporal derivative。通常，我们建议保留它的设置（我们后面将再次设置它），但是为了获得一个非常简单的初始设计，我们现在将其取消设置。

Setup **EV2** (Word-shadowing): Chose a name (for example **Shad** and change **Basic shape** to **Custom (3 column format)** and this time select the file word_shadowing.txt. Same as for **EV1** set **Convolution** to *Double-Gamma HRF*, unset **Add temporal derivative** and leave everything else as the defaults.

设置 EV2 (Word-shadowing)：选择一个名称（例如 Shad，并将 Basic shape 更改为 Custom（3 列格式），然后选择文件 word_shadowing.txt。与 EV1 相同，将 Convolution 设置为 Double-Gamma HRF，取消设置 Add temporal derivative，并将其他所有内容保留为默认值。

Setting up contrasts

Now set up the **Contrasts** (click on the **Contrasts & F-tests** tab). Set the **Number of contrasts** to 5 and enter the following contrasts:

设置对比

现在设置 Contrasts（单击 Contrasts & F-tests 选项卡）。将 Number of contrasts 设置为 5 并输入以下对比：

1. Name the first contrast **Generation**. Set the contrast to be sensitive to the activation in word-generation above and beyond that in rest. [1 0]

2. Name the second contrast **Shadowing**. Set the contrast to be sensitive to the activation in word-shadowing above and beyond that in rest. [0 1]

3. Name the third contrast **Mean**. Set the contrast to be sensitive to the mean activation in word-generation and word-shadowing being larger than in rest. [1 1]

4. Name the fourth contrast **Shad > Gen**. Set the contrast to be sensitive to the activation in word-shadowing above and beyond that in word-generation.[-1 1]

5. Name the fifth contrast **Gen > Shad**. Set the contrast to be sensitive to the activation in word-generation above and beyond that in word-shadowing. [1 -1]

1. 将第一个对比命名为 Generation。设置对比使其对 word-generation 大于静息的激活敏感。[1 0]

2. 将第二个对比命名为 Shadowing。设置对比使其对 word-shadowing 大于静息的激活敏感。[0 1]

3. 将第三个对比命名为 Mean。设置对比使其对 word-generation 和 word-shadowing 的平均激活大于静息的激活敏感。[1 1]

4. 将第四个对比命名为 Shad>Gen。设置对比使其对 word-shadowing 大于 word-generation 的激活敏感。[-1 1]

5. 将第五个对比度命名为 Gen> Shad。设置对比使其对 word-generation 大于 word-shadowing 的激活敏感。[1 -1]

Next set up an **F-test**. Set the **Number of F-tests** to 1 and select the first two contrasts. This spans both conditions and will show you any areas where there is significant activation by Word-generation *AND/OR* Word-shadowing. Thus the sixth output colour overlay image produced will show where either generation or shadowing activation (or both) occurs; i.e. it will show both on a single image.

接下来设置一个 F-test。将 Number of F-tests 设置为 1，然后选择前两个对比。这涵盖了两种情况，并会向您显示 Word-generation 和/或 Word-shadowing 产生显着激活的任何区域。因此，生成的第六个彩色叠加图像输出将显示 generation 或 shadowing 的激活（或两者都有）位置；即它将同时显示在单个图像上。

If you would set up a second F-tests that has contrasts 3 and 4 selected, what would the resulting map show?

- Regions in which both the mean and the difference between word shadowing and word generation contrasts showed significant effects
- Regions in which either the mean contrasts, or the difference between word shadowing and word generation (regardless of the direction of the difference) showed significant effects
  Correct! The F-test is sensitive to both Shad > Gen and to Gen > Shad, and also to both negative and positive mean effects
- Regions in which either the mean contrasts, or the difference between word shadowing and word generation (only when Shad > Gen, but not for Gen > Shad) showed significant effects

如果您要设置第二个 F 检验，并选择了对比 3 和 4，那么结果图将显示什么？

- word shadowing 和 word generation 对比间均值和差异都显着的区域
- word shadowing 和 word generation 对比间的均值或差异（不论是哪个比较方向）显著的区域
  正确！ F 检验对 Shad> Gen 和 Gen> Shad 均敏感，对负和正均值均敏感
- word shadowing 和 word generation 对比间的均值或差异（仅 Shad> Gen，而非 Gen> Shad）显著的区域

Bonus question: Will the F-test with contrasts 1 and 2, and the F-tests with contrasts 3 and 4 result in the same maps or in different maps?

额外的问题：对比 1 和 2 的 F 检验，以及对比 3 和 4 的 F 检验会得出相同的图谱还是不同的图谱？

Answer: The F-test asks whether any combination of the selected contrasts explains a significant portion of the variance in the data. Any contrast that can be created by combining contrasts 1 and 2 can also be created by combining contrasts 3 and 4 and the other way around. For example, contrast 3 can be created by adding contrasts 1 and 2. So an F-test with contrasts 3 and 4 would end up testing all the same possible combinations as an F-test with contrasts 1 and 2 and hence give exactly the same results. Feel free to add an additional F-test with contrasts 3 and 4 to test this.

答案：F 检验询问所选对比的任何组合是否解释了数据差异的很大一部分。可以通过组合对比 1 和 2 来创建的任何对比，也可以通过组合对比 3 和 4 来创建，反之亦然。例如，可以通过添加对比 1 和 2 来创建对比 3。因此，对比 3 和 4 的 F 检验与对比 1 和 2 的 F 检验最终将测试相同的可能组合，因此得出的结果完全相同。你可以运行额外的对比 3 和 4 的 F-test 来进行测试。

Press **View design**. Make sure you understand the resulting design matrix. Time goes down the page, with every 10 TRs ticked off on the left. The red bar shows the width of the highpass filter (the amplitude of any signal much longer than it will get reduced). There are 2 columns in the design corresponding to our predictions about BOLD activity from Word-generation and Word-shadowing respectively.

点击 View design。确保您了解最终的设计矩阵。时间轴沿页面方向向下，左侧每 10 个 TR 都被选中。 红色条显示高通滤波器的宽度（幅值比它长得多的信号会被消减）。在设计中有 2 列分别对应于我们根据 Word-generation 和 Word-shadowing 对 BOLD 活动的预测。

Hopefully they will be familiar from the talk you have just heard. The contrasts appear at the bottom of the image, with the F-test to the right of the contrasts. Note that you can make the design matrix display disappear just by clicking on it once. For now, leave the design matrix display up (Press View design again if necessary).

希望你在刚才课堂上已经对它们有所熟悉。对比出现在图像的底部，F 检验在对比的右边。请注意，只需单击一下，就可以使设计矩阵显示消失。现在，保留设计矩阵显示（如有必要，请再次点击 View design）。

Temporal derivatives

Now, return to the **EVs** tab and FOR BOTH EVs select **Add temporal derivative**.

时间导数

现在，返回到 EVs 选项卡，并为两个 EV 选择 Add temporal derivative。

Press **View design** again. You now see 4 columns with columns 1 and 3 being the same as before and column 2 and 4 being "new". These are the temporal derivatives that are used to correct for timing errors caused either by slight experimental errors in synchronising the times of the scanner with the stimulus presentation and/or inter-subject differences in the delay inherent in the HRF. Now press "Done" and dismiss the view of the design matrix.

再次点击 View design。现在，您将看到 4 列，其中第 1 列和第 3 列与之前相同，第 2 列和第 4 列为“新”。这些是时间导数，用于校正在将扫描仪的时间与刺激信号同步时出现的轻微实验错误，和/或 HRF 固有延迟的被试间差异导致的时间误差。现在点击 Done 并关闭设计矩阵的视图。

Do you remember that we said we should return to the issue of **High pass filtering** once we knew the design (and with that the expected frequency content of the signal we expect/hope to see)? Now the time has come. Press the **Data**-tab to make sure that **High pass filter cutoff (s)** is set to 100. Next press the **Misc**-tab where there will be a button saying **Estimate High Pass Filter**. Press this button and then go back to the **Data**-tab to see what has happened. This should now have changed to 90 seconds. FSL has calculated this for you by analysing the frequency content of the design and then selected a cutoff so that 90% of our expected signal is still in the data after filtering. (N.B. that it is just a fluke that 90% happened to translate into 90 seconds in this particular case)

您还记得我们曾经说过，一旦我们了解了设计（和我们希望看到的信号的预期频率内容），我们就会回到 High pass filtering 吗？现在是时候了。按 Data 选项卡，确保将 High pass filter cutoff (s)设置为 100。接下来，点击 Misc 选项卡，其中有一个按钮显示 Estimate High Pass Filter。点击此按钮，然后返回到 Data 选项卡查看发生了什么。现在应该更改为 90 秒。FSL 已通过分析设计的频率内容为您计算了这一点，然后选择了一个截止值，以便过滤后数据中仍存在 90%的预期信号。（注：90%转化为 90 秒只是本实例中的一个巧合。）

Look at the **Post-stats** section - the defaults are fine; cluster-based thresholding will be carried out.

查看 Post-stats 部分-保留默认值即可；我们将执行基于群集的阈值设置。

What does high pass filtering do to your data?

- It removes frequencies that are faster than the cutoff, which mainly contain noise
- It removes frequencies that are slower than the cutoff, in order to remove noise

  Correct! Fluctuations that are slower than the cutoff are filtered out of the data. This is useful to remove scanner drift (a slow change in the measured signal from the start to the end of the scan)
- It performs temporal smoothing of the timeseries

高通滤波对您的数据有什么么作用？

- 它去除了比截止频率更快的频率，该频率主要包含噪声
- 它去除比截止频率慢的频率，以去除噪声

  正确！比截止频率慢的波动将从数据中滤除。这对于消除扫描仪漂移（从扫描开始到结束的测量信号缓慢变化）很有用。
- 它执行时间序列的时间平滑

Registration

Select the **Registration** tab. By default FEAT will register the middle-timepoint FMRI image (saved as example_func in the .feat output directory) to the standard space template. We recommend in general turning on the **Main structural image** option so that the lowres FMRI image is first registered to a brain-extracted highres structural image from the same subject; this highres image is then registered to the standard space template, and then the two registrations are combined to give an example_func2standard.mat transform which can be used later to resample the FMRI stats into standard space.

Set the **Main structural image** file to structural_brain.nii.gz with 7 DOF (note that we have already run BET on this, and in order to save time in this practical session we are not using the BBR method, but we *strongly* recommend that BBR is used generally). Leave **Standard space** turned on with MNI152_T1_2mm_brain.nii.gz selected and set the DOF to 12. Instead of the linear (12 DOF) registration we are using here, the more accurate nonlinear registration is normally recommended for registration to MNI space by selecting the "nonlinear" option, but we use linear here as it is faster for this practical.

配准

选择 Registration 选项卡。默认情况下，FEAT 将把中间时间点的 FMRI 图像（在.feat 输出目录中保存为 example_func）配准到标准空间模板。我们建议通常打开 Main structural image 选项，以使低分辨率 FMRI 图像首先与来自同一被试者的大脑提取后的的高分辨率结构图像配准。然后，将此高分辨率图像配准到标准空间模板，然后将这两步配准组合在一起，以给出 example_func2standard.mat 变换，该转换可在以后用于将 FMRI 统计信息重采样到标准空间中。

将 Main structural image 设置为 7 DOF 的 structural_brain.nii.gz（请注意，我们已经对此进行了 BET，并且为了节省时间，在本练习中我们不使用 BBR 方法，但是通常我们强烈建议您使用 BBR）。在选择 MNI152_T1_2mm_brain.nii.gz 的情况下，保持 Standard space 为打开状态，并将 DOF 设置为 12。我们在这里使用线性（12 DOF）配准以节省时间，但通常我们建议你选择更加精确的“非线性”选项。

Go!

You are now ready to run FEAT. Press **Go**. A web browser should appear, and as FEAT completes the different stages of processing, you will see messages appear in the **Log** section. Whether the web browser (and indeed the FEAT GUI) is left displayed or is closed, FEAT will continue to run in the background. For now, leave the web browser open so that you can monitor FEAT's progress. FEAT will take 2-5 minutes to complete.

GO！

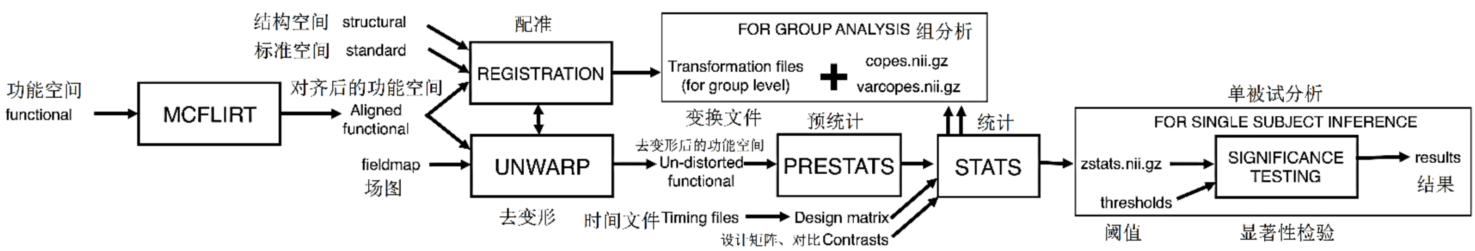
您现在可以运行 FEAT 了。点击 Go。应该会弹出一个网络浏览器，并且随着 FEAT 完成处理的不同阶段，您将在 Log 部分看到不同消息的出现。无论 Web 浏览器（甚至是 FEAT GUI）是处于显示状态还是处于关闭状态，FEAT 都会继续在后台运行。现在，让网络浏览器保持打开状态，以便您可以监控 FEAT 的进度。FEAT 需要 2-5 分钟才能完成。

While you wait

Take a look at the flow diagram below which summarises all of the steps that you just set up in Feat. Hopefully it will help you to see the big picture, and avoid getting bogged down in the details:

在你等待的时候

查看下面的流程图，该流程图总结了您刚刚在 Feat 中设置的所有步骤。希望它可以帮助您纵览全局，并避免在细节中陷入困境：



Whilst FEAT is running, run FSLeyes to have a quick look at the different images mentioned above: start by looking at structural_brain.nii.gz, and then view fmri.nii.gz. Note that when viewing the 4D image you can see the image time series as a movie by pressing on the movie icon ( ), and you can also see time series plots by pressing *View > Timeseries*.

Create a mask to probe statistics

Whilst FEAT is still running, we will now use FSLeyes to create a mask in standard space that will be used later to find out about activation statistics from within the mask. An alternative method to create a mask was explained in the Registration practical.

1. Reopen FSLeyes and load the standard space template image $FSLDIR/data/standard/MNI152_T1_2mm ($FSLDIR is an environment variable indicating the directory in which FSL is installed, you can type `echo $FSLDIR` to see what this is set to). Inside FSLeyes you can use the *File -> Add standard* menu option to find these standard space images quickly.

在运行 FEAT 的同时，运行 FSLeyes 以快速查看上述不同的图像：首先查看 structure_brain.nii.gz，然后查看 fmri.nii.gz。 请注意，在查看 4D 图像时，您可以通过按电影图标（ ）来以电影的形式查看图像时间序列，也可以通过点击 View > Timeseries 来查看时间序列图。

创建掩码以探查统计信息

当 FEAT 仍在运行时，我们现在将使用 FSLeyes 在标准空间中创建一个掩板，稍后将使用该它从掩板中查找有关激活的统计信息。在配准实操中介绍了创建掩板的另一种方法。

1. 重新打开 FSLeyes 并加载标准空间模板图像 $ FSLDIR / data / standard / MNI152_T1_2mm（$ FSLDIR 是一个环境变量，指示 FSL 的安装目录，您可以键入 echo $ FSLDIR 来查看其设置）。在 FSLeyes 内，您可以使用 File -> Add standard 菜单选项来快速查找这些标准空间图像。

2. Open the atlas panel via *Settings -> Ortho View 1 -> Atlas* panel, and enable the *Harvard-Oxford cortical*, *Harvard-Oxford subcortical* and *Juelich Histological* atlases. Move the cursor around a little in the standard brain and see how the labels and numbers in the atlas tool window changes. If you have a favourite part of the brain and you happen to know where it is you can move the cursor there and see if the atlas tool agrees with you.

3. Now select the *Atlas search* tab in the atlas panel, and choose the *Juelich Histological Atlas* from the list on the left. You will now see a list of all the structures in that atlas on the right.

4. Type `ba4` in the text box above the structure list to filter the structures that are shown. Click the check boxes next to **GM Broca's area BA44 L** and **GM Broca's area BA45 L**.

2. 通过 Settings -> Ortho View 1 -> Atlas 面板打开图集面板，然后启用 Harvard-Oxford cortical, Harvard-Oxford subcortical 和 Juelich Histological 图集。在标准大脑中稍微移动一下光标，然后查看图集工具窗口中的标签和数字如何变化。如果您有最爱的大脑部分，并且碰巧知道它在哪里，则可以将光标移到那里，然后查看图集工具是否与您的认知一致。

3. 现在，在图集面板中选择 Atlas search 搜索选项卡，然后从左侧列表中选择 Juelich Histological Atlas。现在，您将在右侧的图集中看到所有结构的列表。

4. 在结构列表上方的文本框中键入 ba4 以过滤显示的结构。单击 GM Broca 的 BA44 L 区域和 GM Broca 的 BA45 L 区域旁边的复选框。

5. You will notice that in the FSLeyes overlay list, two images have been added with name corresponding to the regions you just selected. If you select one of those and then move the cursor around you will notice its intensity values in changing between 0 and 100. These values reflect the probability that a given voxel (cursor position) is indeed part of that structure.

5. 您会注意到，在 FSLeyes 覆盖列表中，添加了两个图像，其名称与您刚选择的区域相对应。如果选择其中一个，然后在周围移动光标，您会注意到其强度值在 0 到 100 之间变化。这些值反映了给定体素（光标位置）确实是该结构的一部分的可能性。

6. Press the save icon ( ) next to the image **juelich/prob/GM Broca's area BA44 L** in the overlay list and save the image to a file called BA44. Repeat this process for BA45.

6. 点击覆盖列表中图像 juelich/prob/GM Broca's area BA44 L 旁边的保存图标（），然后将图像保存到名为 BA44 的文件中。对 BA45 重复此过程。

7. What we will do next is to create a mask which has the value 1 for each voxel that has a 50% or greater chance of belonging to BA44 and/or BA45. We do this by typing (in the terminal window):

7. 接下来，我们将创建一个掩板，对于每个具有 50%或更大的机会属于 BA44 和/或 BA45 的体素，其值为 1。我们通过在终端窗口中输入以下内容来实现：

```
fslmaths BA44 -add BA45 -thr 50 -bin Broca
```

The end result of this is a file named Broca.nii.gz that we will later use as a mask to plot time-series of our results. If you want to convince yourself that this file indeed contains what it should you can type and have a look.

最终的结果是一个名为 Broca.nii.gz 的文件，稍后我们将其用作掩板以绘制结果的时间序列。如果确认该文件确实包含相关的内容，你可以输入：

```
fsleyes -std Broca -cm red
```

Look at the EV specification

Lastly, whilst FEAT is running take a look at the files that we used to specify our design, i.e. word_generation.txt and word_shadowing.txt. We do this by typing (still in the terminal window):

查看 EV 规格

最后，在 FEAT 运行时，请查看用于指定设计的文件，即 word_generation.txt 和 word_shadowing.txt。 我们通过键入（仍然在终端窗口中）来做到这一点：

```
more word_generation.txt
```

The more command will show you the contents of the file (type q to quit if the terminal doesn't give you your prompt back). Once you've finished looking at word_generation.txt, run `more word_shadowing.txt` to look at the timing information for the word shadowing task.

more 命令将向您显示文件的内容（如果终端没有给予你提示，则键入 q 退出）。查看完 word_generation.txt 后，请运行 more word_shadowing.txt 来查看 word shadowing 任务的时间信息。

There are three columns in these files, what information does the first column contain?

- Start time of the event (in seconds)

  Correct! Start times are relative to the start of the scan. In event-related studies like this it is crucial to get the timings right (down to a second) so it is often a good idea to have the start of stimulus presentation to be triggered by the scanner.
- Duration of the event (in seconds)
- Magnitude of the expected response

这些文件中有三列，第一列包含哪些信息？

- 事件的开始时间（单位 s）

  正确！开始时间是相对于扫描开始的时间。在此类事件相关的研究中，正确计时（缩短至一秒）至关重要，因此由扫描仪触发刺激呈现通常是一个好主意。
- 活动持续时间（单位 s）
- 预期响应的幅度

While FEAT is running it will display **STILL RUNNING** in the main FEAT report page, which is replaced by **Finished at ...** when it is done. Once FEAT has finished, look carefully at the various sections of the web page report, including motion correction plots in the Pre-stats section, the colour-rendered activation images and timeseries plots in the Post-stats section, and the Registration results. Note that if you click on the activation images you get a table of cluster co-ordinates.

当 FEAT 运行时，它将在 FEAT 主报告页面中显示 STILL RUNNING，完成后将替换为 Finished at...。 FEAT 完成后，请仔细查看网页报告的各个部分，包括 Pre-stats 部分中的运动校正图，Post-stats 部分中的彩色渲染激活图像和时间序列图以及配准结果。请注意，如果你单击激活图像，则会得到一个群集坐标表。

Featquery

Featquery allows you to calculate certain data statistics, either at a voxel of interest, or averaged over a region of interest using a mask. We will use the standard-space mask which we created earlier. Start up Featquery from the terminal:

Featquery

Featquery 允许您计算特定的数据统计信息，既可以在感兴趣的体素上计算，也可以使用掩板在感兴趣区域上取平均值。我们将使用我们之前创建的标准空间掩板。从终端启动 Featquery：

```
Featquery &
```

(or `Featquery_gui &` if you are on a Mac).

(Mac 上则输入 Featquery_gui &)

Select the fmri.feat directory created by your first analysis on the fmri-fluency dataset.

选择你首次对 fmri-fluency 数据集分析时创建的 fmri.feat 目录。

Featquery automatically reads the FEAT directory and gives you the appropriate options as to which statistics you can choose to investigate.

Featquery 自动读取 FEAT 目录并为您提供适当的选项，以供您选择要调查的统计信息。

1. Select the following statistics for the contrast that looks at activation for word-generation (i.e. the **[1 0]** contrast), the contrast that looks at activation for word-shadowing (i.e. the **[0 1]** contrast) and the contrast that looks at activation for word-generation over and above word-shadowing (i.e. the **[1 -1]** contrast), i.e. contrasts number 1, 2 and 5:
   - **stats/cope** (unthresholded contrast of parameter estimate)
   - **stats/tstat** (unthresholded t statistics)
   - **stats/zstat** (unthresholded z statistics)
   - **thresh_zstat** (thresholded z statistics)

1. 选择以下统计数据，用于查看 word-generation 激活的对比（即[1 0]对比），word-shadowing 激活的对比（即[0 1]对比）和 word-generation 激活大于 word-shadowing 的对比（即[1 -1]对比），即对比 1、2 和 5：
   - **stats/cope**（未阈值化的参数估计对比）
   - **stats / tstat**（未阈值化的 t 统计）
   - **stats / zstat**（未阈值化的 z 统计）
   - **thresh_zstat**(阈值化的 z 统计）

2. In the **Input ROI selection** panel, enter the mask that you created earlier (i.e. Broca.nii.gz) as the **Mask Image** (note - Featquery can take either a standard-space mask OR a lowres one in the original dataspace OR a mask in the space of the structural image)

2. 在 Input ROI selection 面板中，输入您之前创建的掩板（即 Broca.nii.gz）作为 Mask Image（注意-Featquery 可以在原始数据空间里使用标准空间掩板或低分辨率掩板，也可以在结构图像空间里使用掩板。）

3. In the **Output options** section, select the **Convert PE/COPE values to %** option

4. Select the **Do not binarise mask (allow weighting)** option

5. Select an atlas (inside the Output options section), for example the **Harvard-Oxford Cortical Structural Atlas**. The local maxima voxels reported by Featquery will be related to structures in the selected atlas.

6. Press **Go** and a web browser showing the estimated statistics should popup shortly (possibly after a minute or two).

3. 在 Output options 部分中，选择 Convert PE/COPE values to %选项

4. 选择 Convert PE/COPE values to %选项

5. 选择一个图集（在 Output 选项部分内），例如 Harvard-Oxford Cortical Structural Atlas。Featquery 报告的局部最大体素将与所选图集中的结构相关。

6. 按下 Go 键，然后会弹出一个显示估计统计信息的 Web 浏览器（可能在一两分钟之后）。

The resulting web page will contain a table summarizing each of the statistics that you asked Featquery to report on in step 1. The first column gives the statistic name. The second column gives the number of non-zero voxels in the mask. The next group of columns gives a summary of the distribution of values within the mask. Finally, the last group of columns contains the position of the maximum in voxel space, in mm space, and in the atlas space selected in step 5. Plots of the timeseries at the maximum z-stats are available by clicking the link labeled "Masked time series plot" just below the image of the mask at the top of the page.

所得的网页将包含一个表，该表汇总了您在步骤 1 中要求 Featquery 报告的每个统计信息第一列提供了统计信息名称。第二列给出了掩板中非零体素的数量。下一组列概述了掩板中值的分布。最后一组列包含在步骤 5 中选择的体素空间，mm 空间和图集空间中最大值的位置。可通过单击页面顶部掩板图像下方标记为"Masked time series plot"的链接来获得最大 z 统计量的时间序列图。

What does the second column ("# voxels") tell you for the copes and t-stats images?

- The number of voxels with statistically significant activation
- The number of voxels with any activation, whether it reaches the statistical threshold or not
- The number of voxels in the Broca mask

  Correct! Even in voxels without any brain activation, there will be some correlation between the contrast timeseries and the image noise, leading to spurious non-zero copes and t-stats. Hence, all voxels within the Broca mask will be non-zero (except for voxels outside of the brain mask).

第二列（"# voxels"）为您提供了有关 copes 和 t-stats images 的什么信息？

- 具有统计显着性激活的体素数量
- 任何激活的体素数量，无论是否该激活达到统计阈值
- Broca 掩板中的体素数

  正确！即使在没有任何大脑激活的体素中，对比时间序列和图像噪声之间也会存在一定的相关性，从而导致虚假的非零值和 t-stats。因此，Broca 掩板中的所有体素都将不为零（掩板外的体素除外）。

—— THE END ——