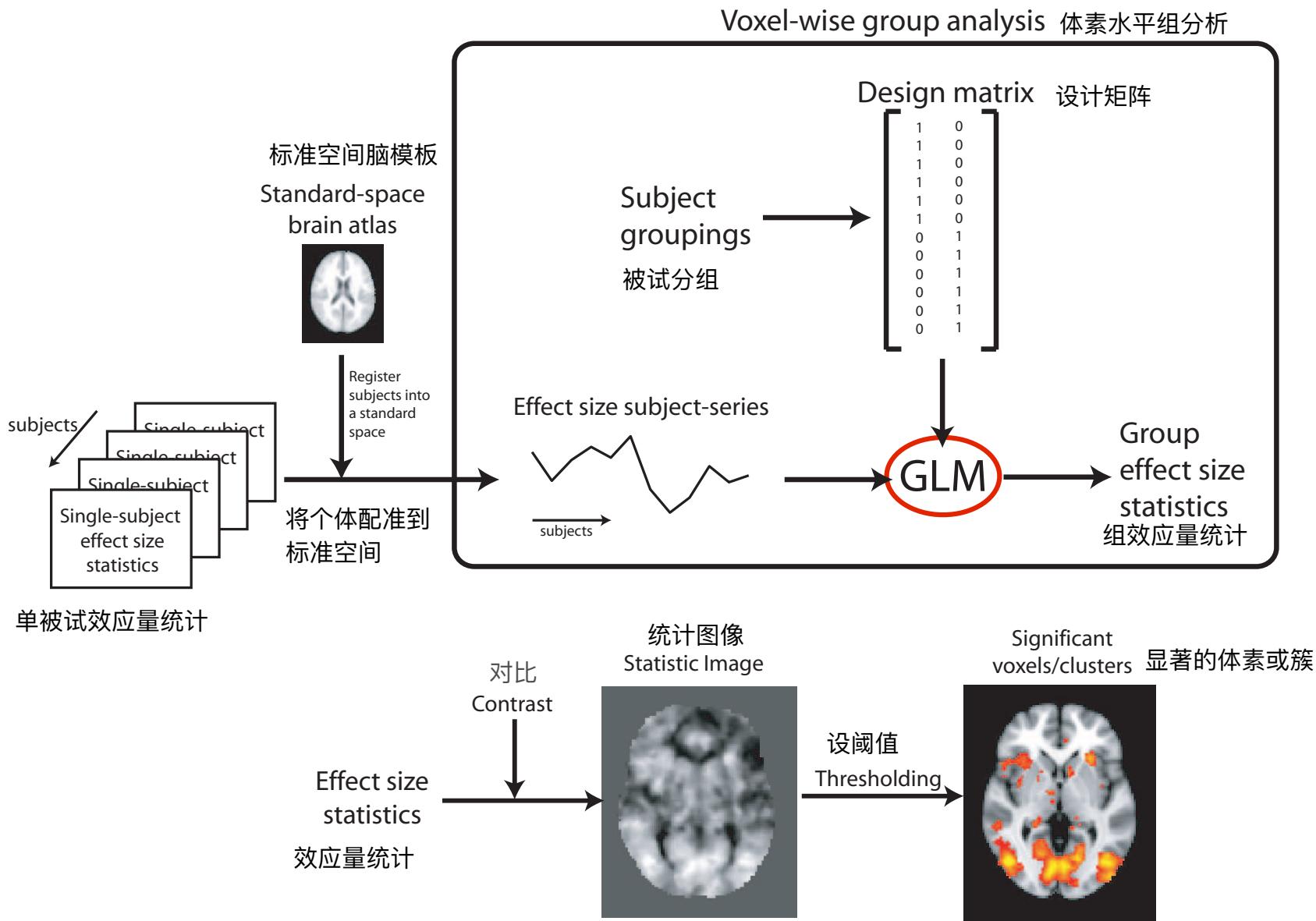




FMRI Group Analysis fMRI组分析

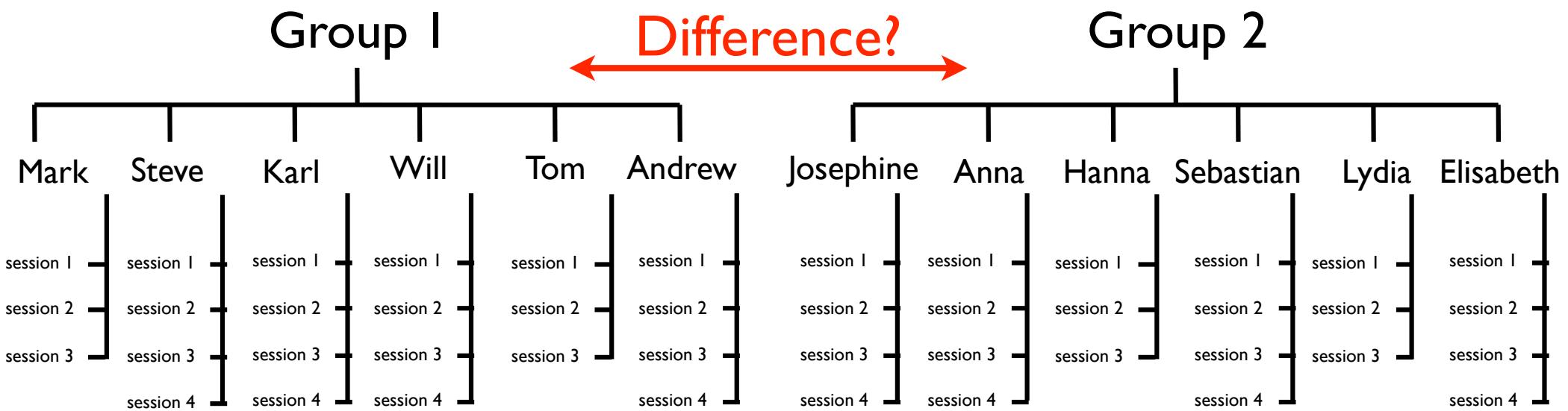




Multi-Level fMRI analysis

多水平fMRI分析

- uses GLM at both lower and higher levels
在高、低水平均使用GLM分析
- typically need to infer across multiple subjects, sometimes multiple groups and/or multiple sessions
通常需要跨多个被试、多个分组和/或多个节段

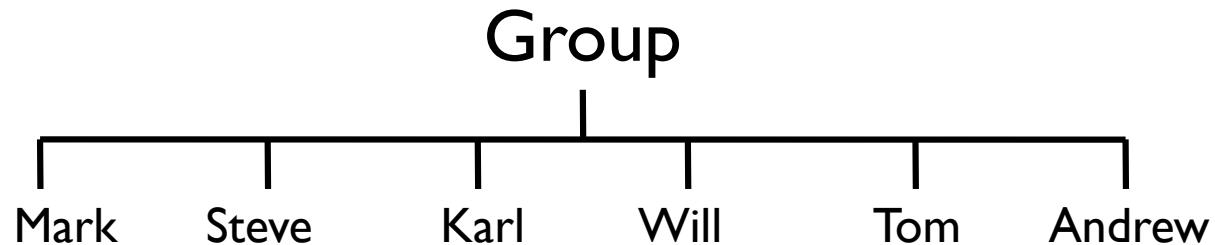


- questions of interest involve comparisons at the highest level 感兴趣的问题涉及最高水平的比较



A simple example

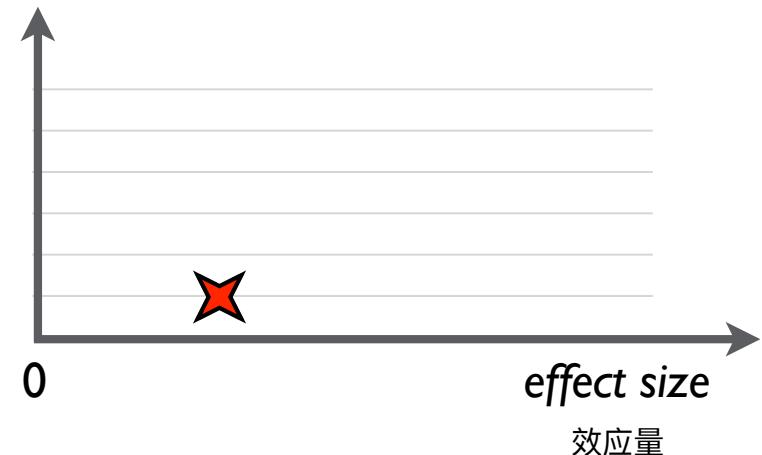
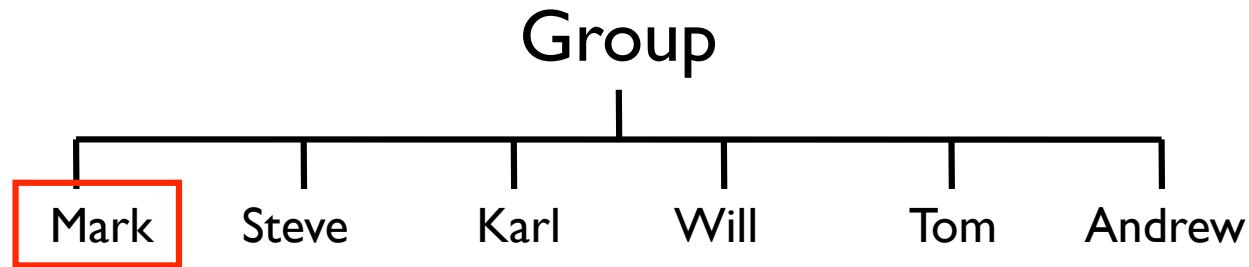
Does the group activate on average? 组激活是平均吗?





A simple example

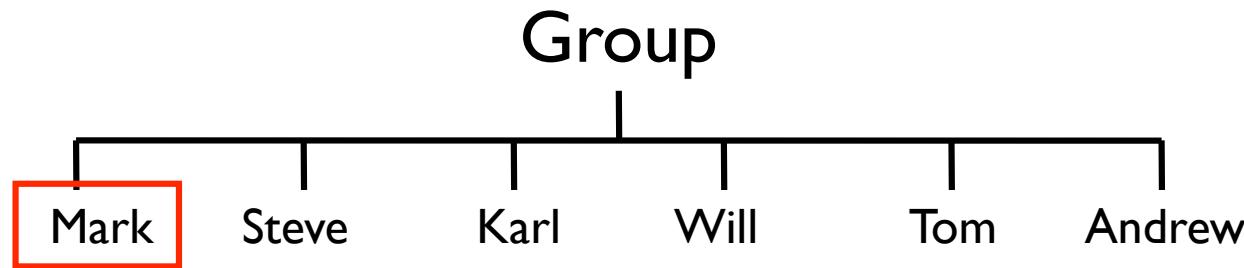
Does the group activate on average? 组激活是平均吗?





A simple example

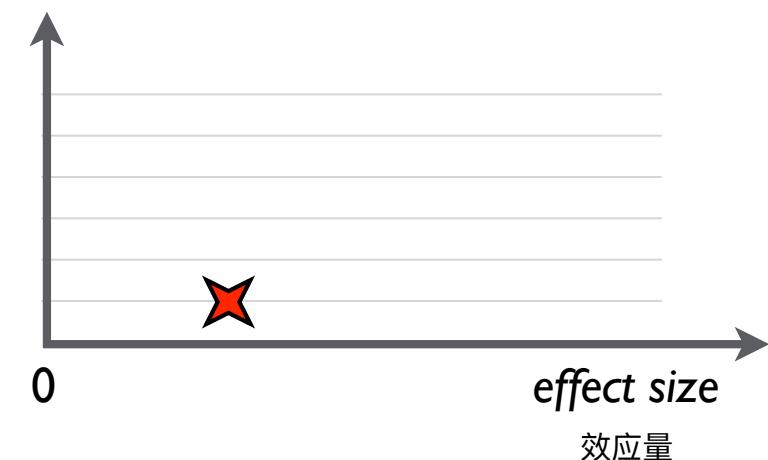
Does the group activate on average? 组激活是平均吗?



$$Y_k = X_k \beta_k + \epsilon_k$$

First-level GLM
on Mark's 4D fMRI
data set

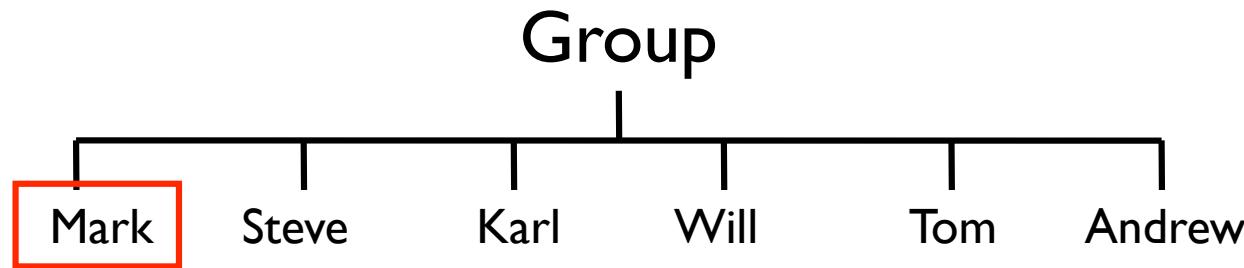
基于被试Mark的4D fMRI的第一水平GLM分析



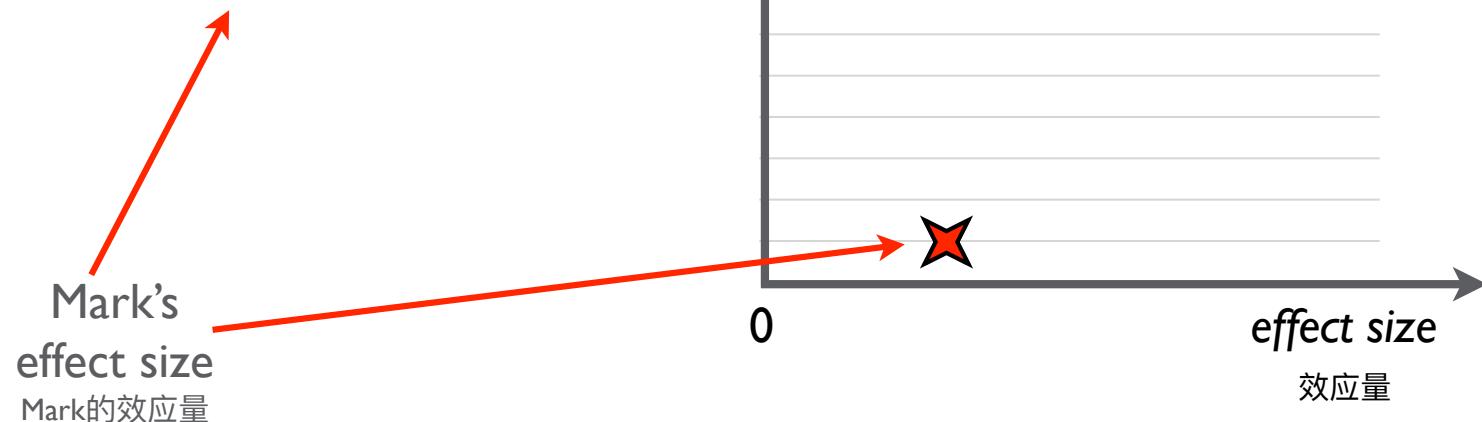


A simple example

Does the group activate on average? 组激活是平均吗?



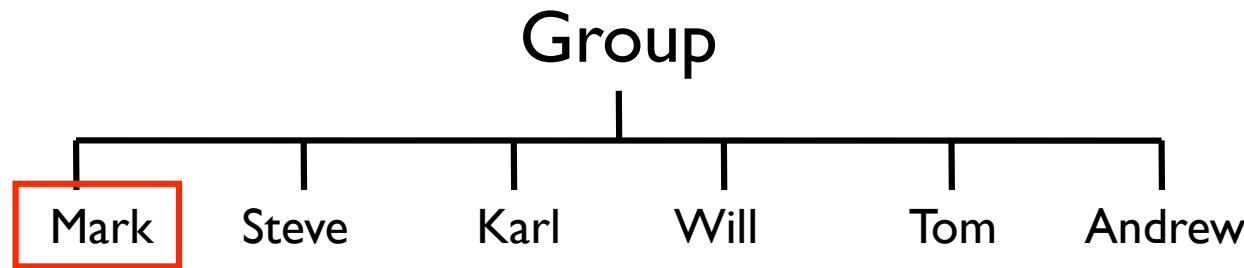
$$Y_k = X_k \beta_k + \epsilon_k$$



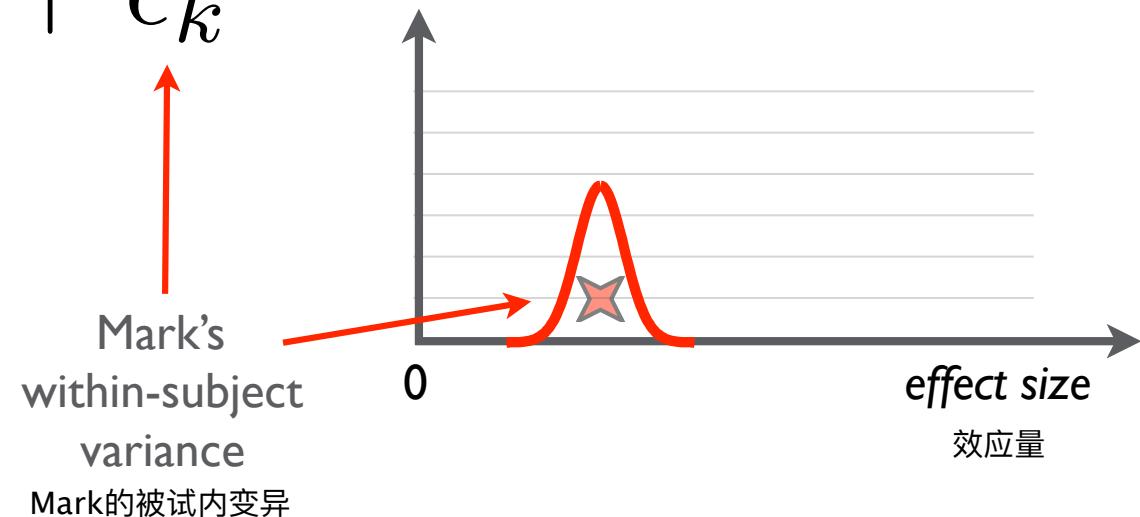


A simple example

Does the group activate on average? 组激活是平均吗?



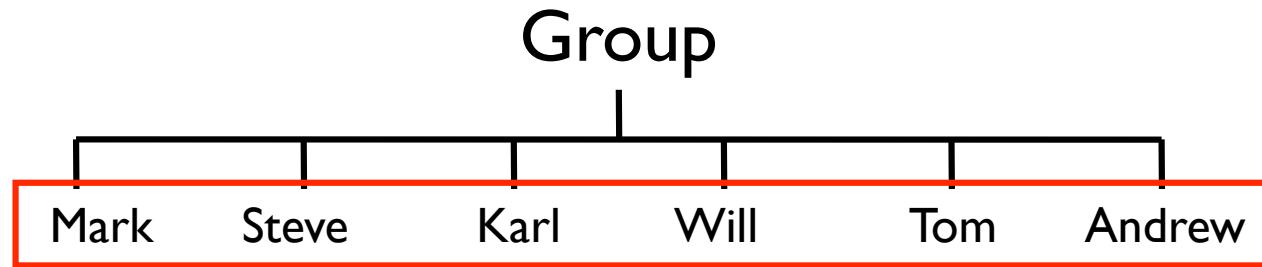
$$Y_k = X_k \beta_k + \epsilon_k$$





A simple example

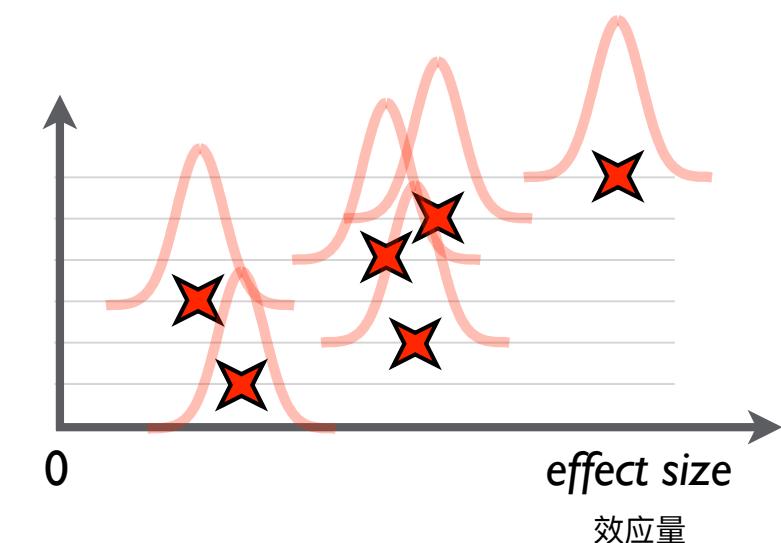
Does the group activate on average? 组激活是平均吗?



$$Y_K = X_K \beta_K + \epsilon_K$$

All first-level GLMs
on 6 fMRI data set

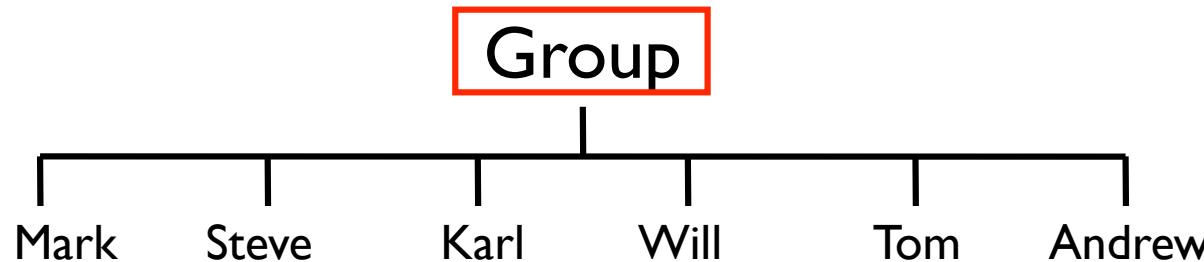
基于6个fMRI数据的第一水平GLM分析





A simple example

Does the group activate on average? 组激活是平均吗?



What group mean are we after? Is it:

- I. The group mean for those exact 6 subjects?

精确的6个被试的组平均?

Fixed-Effects (FE) Analysis 固定效应分析

2. The group mean for the population from which these 6 subjects were drawn? 6个被试所代表的群体的组平均?

Mixed-Effects (ME) analysis 混合效应分析

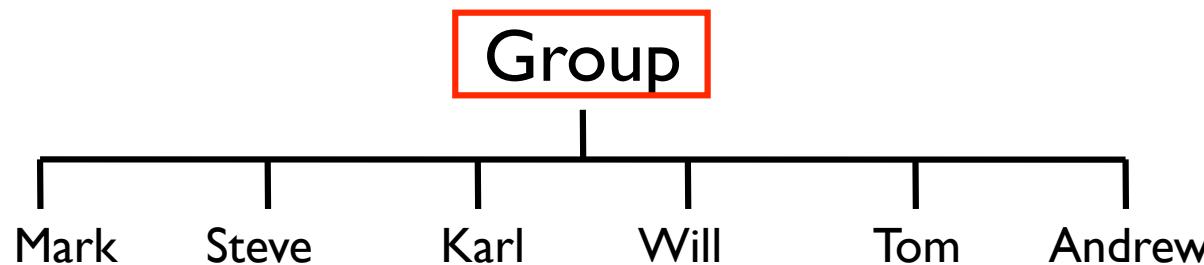


Fixed-Effects Analysis

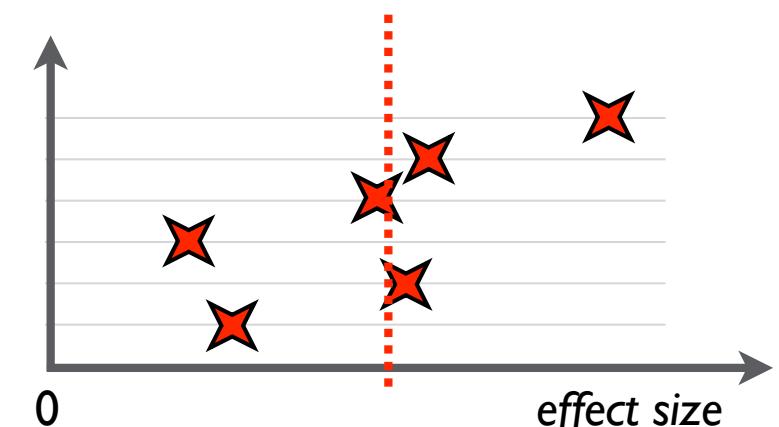
固定效应分析

Do these exact 6 subjects activate on average?

这些是6个被试激活的精确平均值吗？



estimate group effect size as
straight-forward mean
across lower-level estimates
估计组效应的大小作为较低水平估计的直接均值



$$\beta_g = \frac{1}{6} \sum_{k=1}^6 \beta_k$$

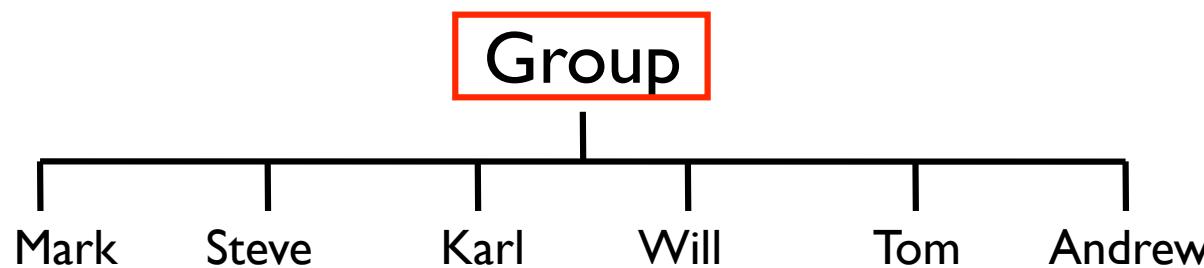


Fixed-Effects Analysis

固定效应分析

Do these exact 6 subjects activate on average?

这些是6个被试激活的精确平均值吗？

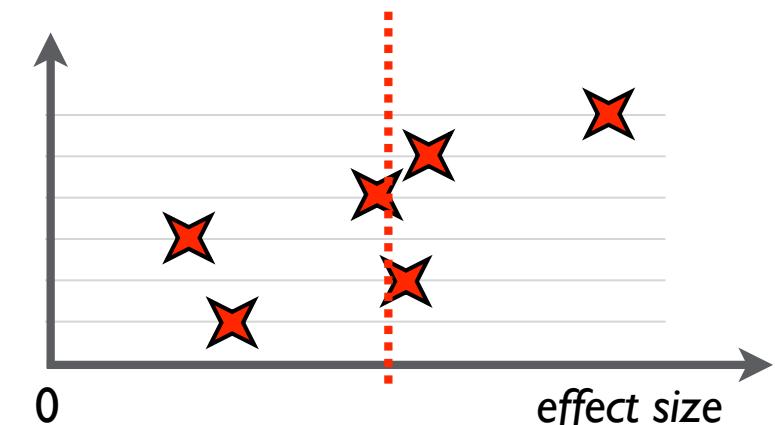


$$Y_K = X_K \beta_K + \epsilon_K$$

$$\beta_K = X_g \beta_g$$

$$X_g = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

Group mean



$$\beta_g = \frac{1}{6} \sum_{k=1}^6 \beta_k$$

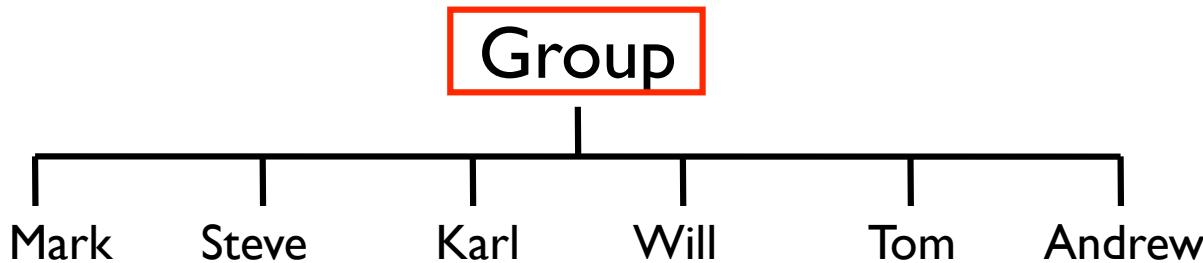


Fixed-Effects Analysis

固定效应分析

Do these exact 6 subjects activate on average?

是6个被试激活的精确平均吗？



$$Y_K = X_K \beta_K + \epsilon_K$$
$$\beta_K = X_g \beta_g$$

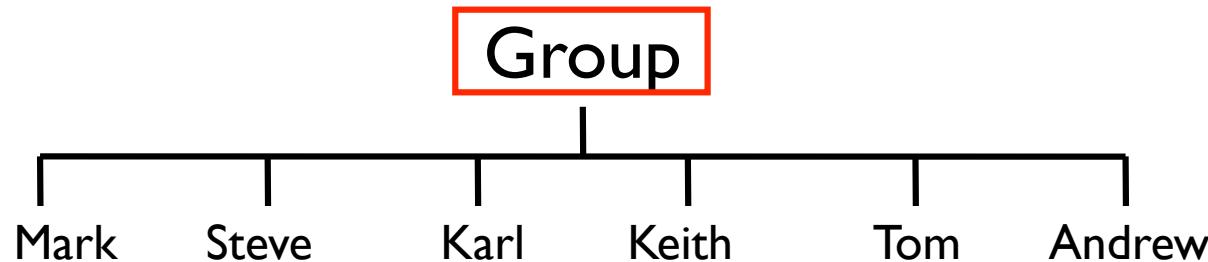
Fixed Effects Analysis: 固定效应分析

- Consider only these 6 subjects 只考虑这6个被试
 - estimate the mean across these subject 根据这些被试估计均值
 - only variance is within-subject variance 只有被试内差异



A simple example

Does the group activate on average? 组激活是平均吗?



What group mean are we after? Is it:

- I. The group mean for those exact 6 subjects?

精确的6个被试的组平均?

Fixed-Effects (FE) Analysis 固定效应分析

2. The group mean for the population from which these 6 subjects were drawn? 6个被试所代表的群体的组平均?

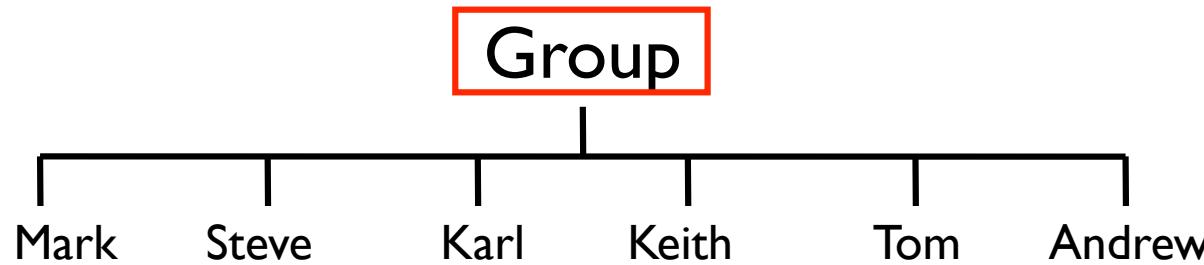
Mixed-Effects (ME) analysis 混合效应分析



Mixed-Effects Analysis

混合效应分析

Does the population activate on average? 这些是群体的平均值吗?

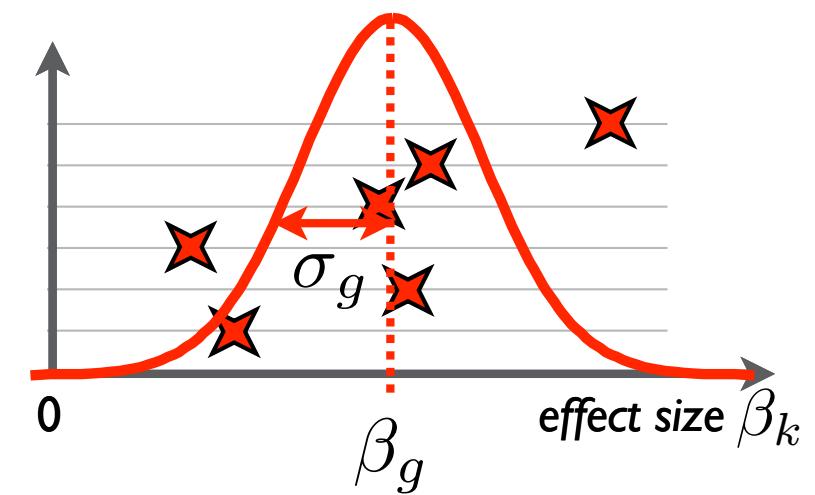


$$Y_K = X_K \beta_K + \epsilon_K$$

Consider the distribution over the population from which our 6 subjects were sampled:

考虑到我们6个被试被抽样的人口分布情况

σ_g^2 is the between-subject variance

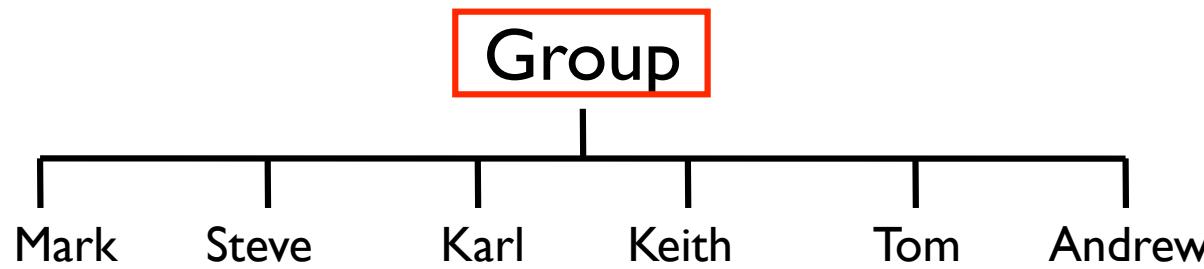




Mixed-Effects Analysis

混合效应分析

Does the population activate on average? 这些是总体的平均值吗?

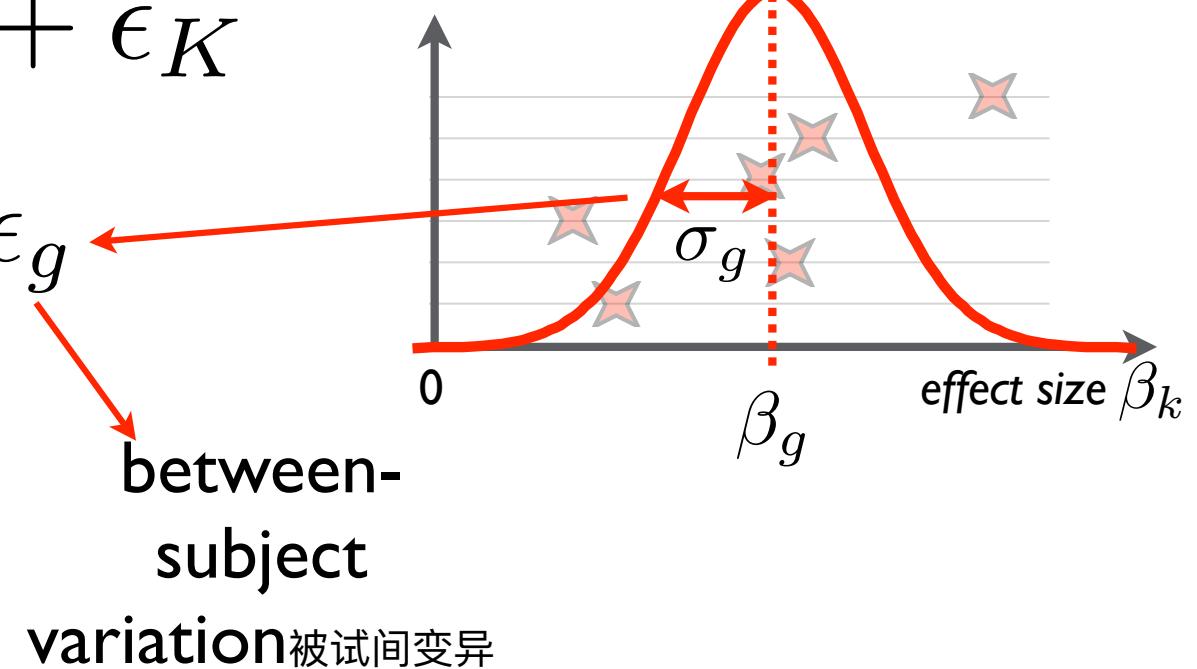


$$Y_K = X_K \beta_K + \epsilon_K$$

$$\beta_K = X_g \beta_g + \epsilon_g$$

$$X_g = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

Population mean 总体均值

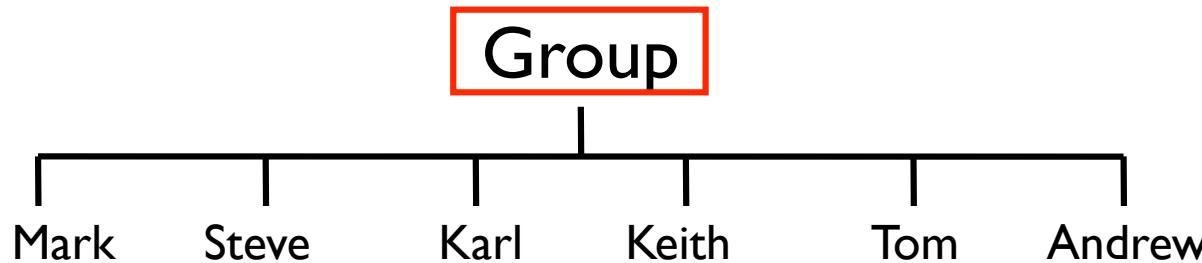




Mixed-Effects Analysis

混合效应分析

Does the population activate on average? 这些是总体的平均值吗?



$$Y_K = X_K \beta_K + \epsilon_K$$
$$\beta_K = X_g \beta_g + \epsilon_g$$

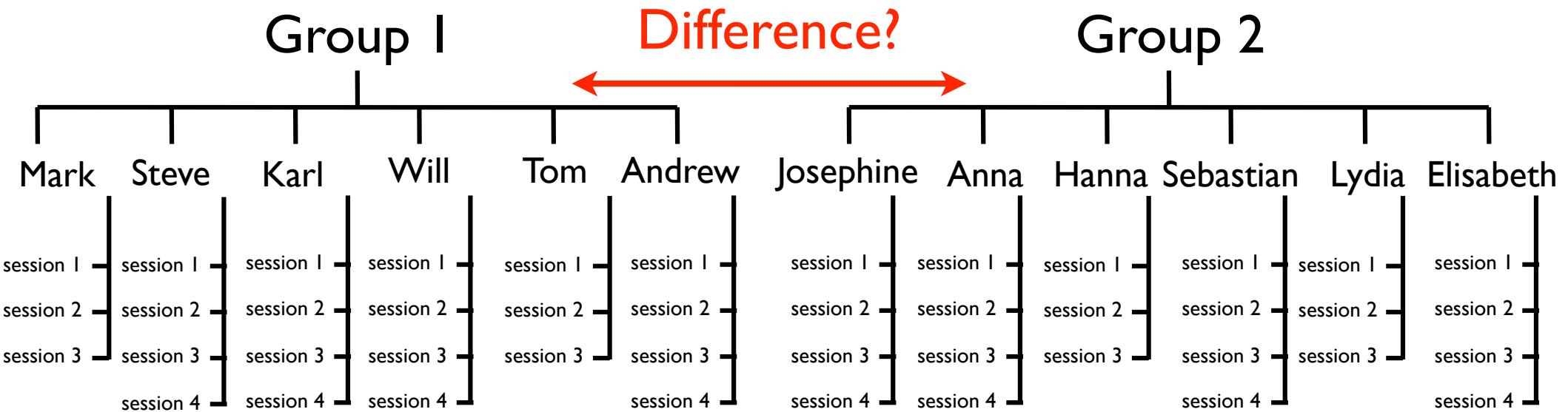
Mixed-Effects Analysis:

- Consider the 6 subjects as samples from a wider population。
认为这6个被试是来自更大总体的样本
 - estimate the mean across the population 估计总体的均值
 - between-subject variance accounts for random sampling
有随机抽样导致的被试间差异



All-in-One Approach

一体式方法



- Could use one (huge) GLM to infer group difference

可以使用一个（大的）GLM推断组间差异

- difficult to ask sub-questions in isolation 难以单独提出子问题
- computationally demanding 计算要求高
- need to process again when new data is acquired 在获取新数据时需要再次处理



Summary Statistics Approach

概述统计方法

In FEAT estimate levels one stage at a time

- At each level: 在每个水平上 在FEAT估计水平的每个步骤

- Inputs are summary stats from levels below (or FMRI data at the lowest level)

输入是来自较低级别的汇总统计信息 (或最低级别的 FMRI 数据)

- Outputs are summary stats or statistic maps for inference

输出是用于推理的汇总统计数据或统计映射

- Need to ensure formal equivalence between different approaches!

需要确保不同方法之间的形式相同

Group
difference

Group

Subject

Session



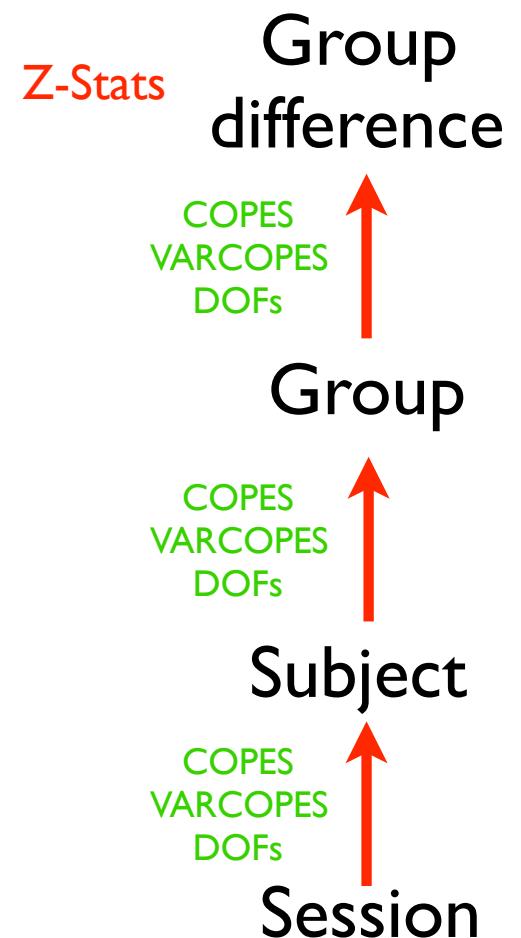


FLAME

FMRIB's Local Analysis of Mixed Effects

FMRIB的混合效应的局部分析方法

- Fully Bayesian framework 完全贝叶斯框架
 - use non-central t-distributions: Input COPES, VARCOPES & DOFs from lower-level
使用非中央 t 分布：输入较低级别的COPES、VARCOPES和DOFs
 - estimate COPES, VARCOPES & DOFs at current level
在当前水平估计COPES、VARCOPES和DOFs
 - pass these up 向上传递
- Infer at top level 在最高水平进行推断
- Equivalent to All-in-One approach
相当于一体式的方法





FLAME Inference

- Default is: 默认:
 - FLAME1: fast approximation for all voxels (using marginal variance MAP estimates)
所有体素的快速近似值（使用边际方差 MAP 估计值）
- Optional slower, slightly more accurate approach:
可选的较慢、稍微更准确的方法:
 - FLAME1+2:
 - FLAME1 for all voxels, FLAME2 for voxels close to threshold
FLAME1 适用于所有体素，FLAME2 用于接近阈值的体素
 - FLAME2: MCMC sampling technique
MCMC采样技术



Choosing Inference Approach

选择推断方法

I. Fixed Effects 固定效应

Use for intermediate/top levels

用于中级/顶级水平

2. Mixed Effects - OLS 最小二乘

Use at top level: quick and less accurate

最高水平使用：快速但不太准确

3. Mixed Effects - FLAME I

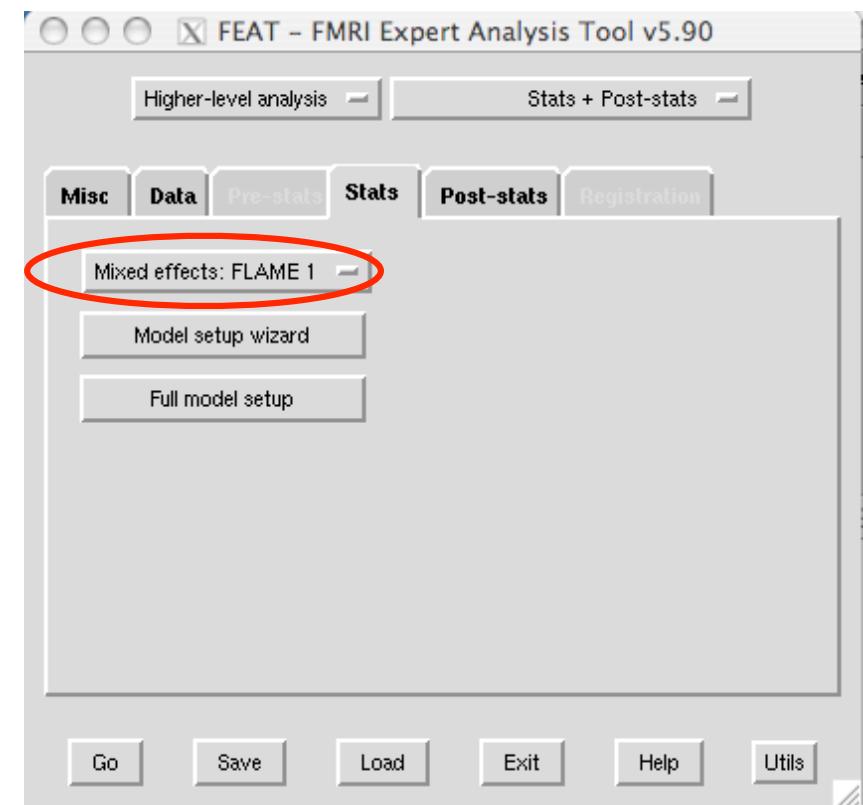
Use at top level: less quick but more accurate

最高水平使用：速度较慢，但更准确

4. Mixed Effects - FLAME I+2

Use at top level: slow but even more accurate

最高水平使用：最慢最准确

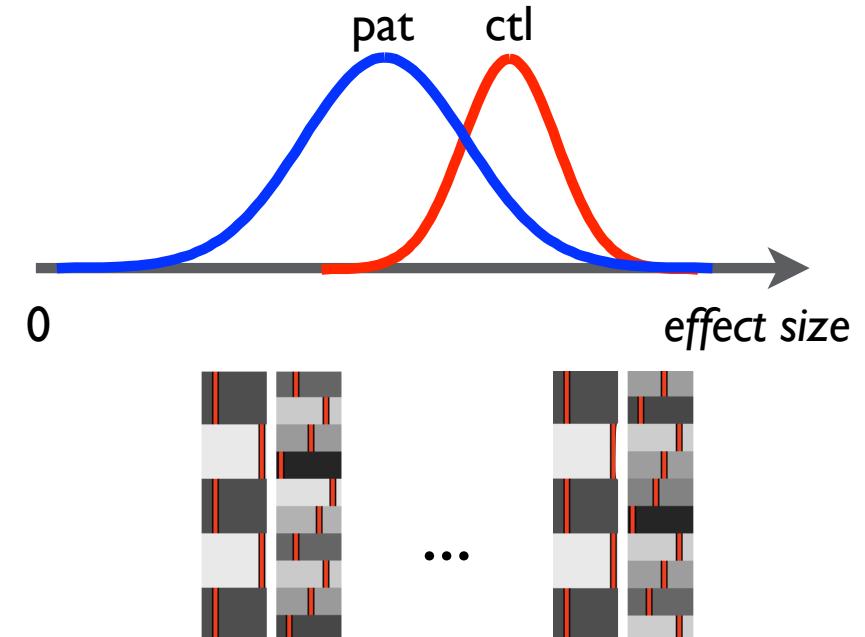




FLAME vs. OLS 对比正交最小二乘法

- allow different within-level variances (e.g. patients vs. controls)

允许不同的组内差异 (例如病人与对照组)



- allow non-balanced designs (e.g. containing behavioural scores)

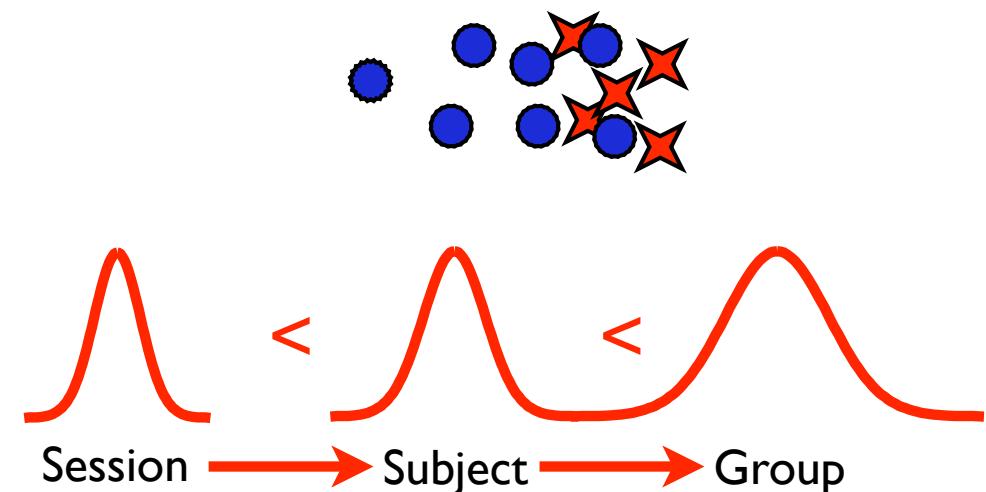
允许非平衡设计 (例如包含行为评分)

- allow un-equal group sizes

允许组间样本量不同

- solve the ‘negative variance’ problem

解决“负方差”问题

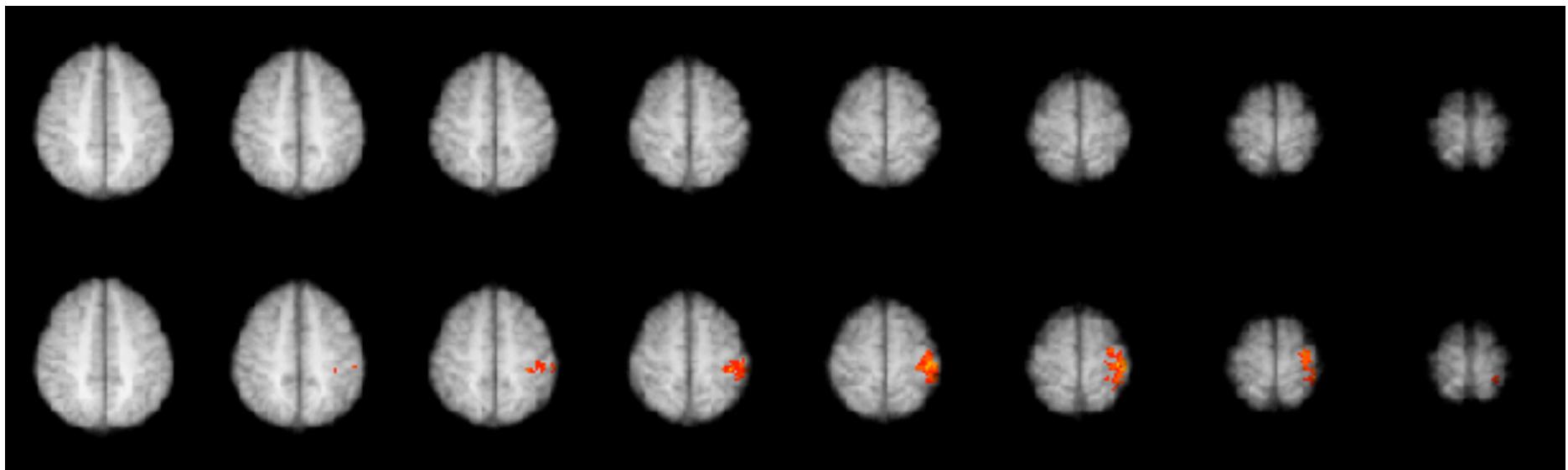




FLAME vs. OLS

- Two ways in which FLAME can give different Z-stats compared to OLS: 与OLS相比, FLAME可以提供两种不同的Z检验方法:
 - *higher Z due to increased efficiency from using lower-level variance heterogeneity*
由于使用较低级别的方差异构性而提高了效率, 因此Z更高

OLS
FLAME



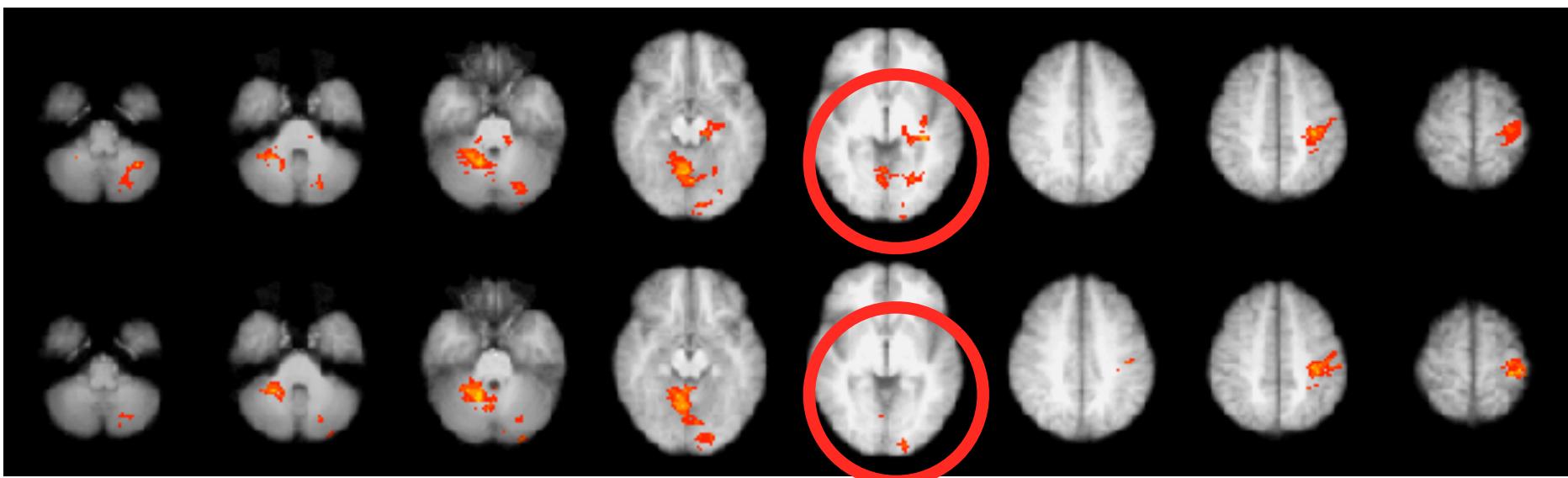


FLAME vs. OLS

- Two ways in which FLAME can give different Z-stats compared to OLS: 与OLS相比, FLAME可以提供两种不同的Z检验方法:
 - Lower Z due to higher-level variance being constrained to be positive (i.e. solve the implied negative variance problem)

由于较高水平的方差被限制为正值, 因此Z值较低 (即解决了负方差问题)

OLS



FLAME



Multiple Group Variances

多组差异

- can deal with multiple group variances

可以处理多组差异

- separate variance will be estimated for each variance group (be aware of #observations for each estimate, though!)

将为每个方差组估算单独的方差（不过请注意观察每个估算值）

- design matrices need to be ‘separable’, i.e. EVs only have non-zero values for a single group

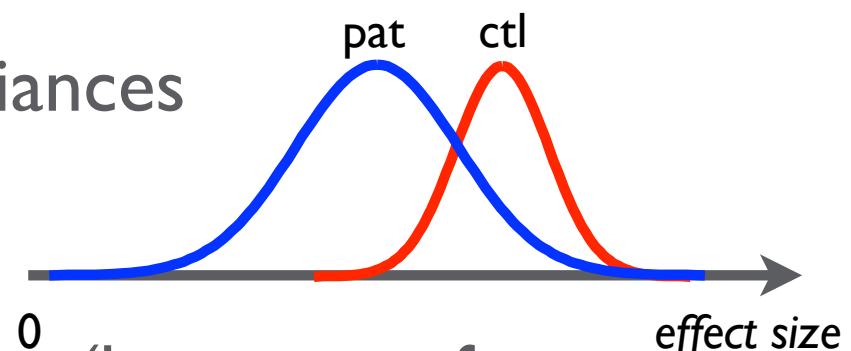
设计矩阵必须“可分离”，即，单个组的EV仅能为非零值

1	1.0	0
1	1.0	0
1	1.0	0
2	0	1.0
2	0	1.0
2	0	1.0

valid

1	1.0	1.0
1	1.0	1.0
1	1.0	1.0
2	1.0	-1.0
2	1.0	-1.0
2	1.0	-1.0

invalid





Examples



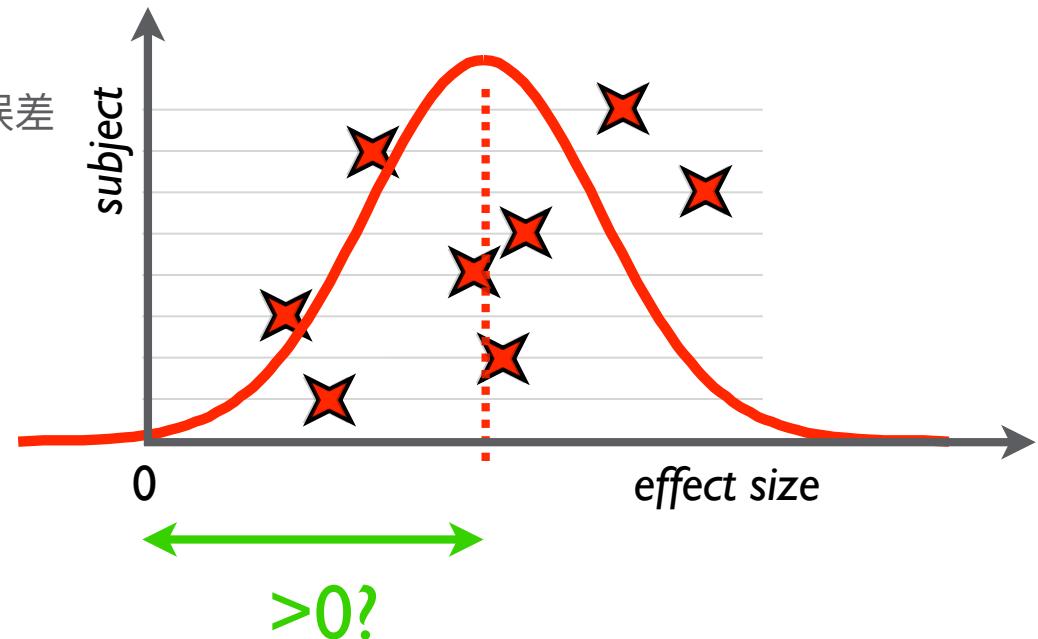
Single Group Average

单组平均值

- We have 8 subjects - all in one group - and want the mean group average: 一组8个被试，求组平均

Does the group activate on average? 组激活是均值吗？

- estimate mean 估计均值
- estimate std-error 估计标准误差 (FE or ME)
- test significance of mean > 0 检测均值的显著性 > 0

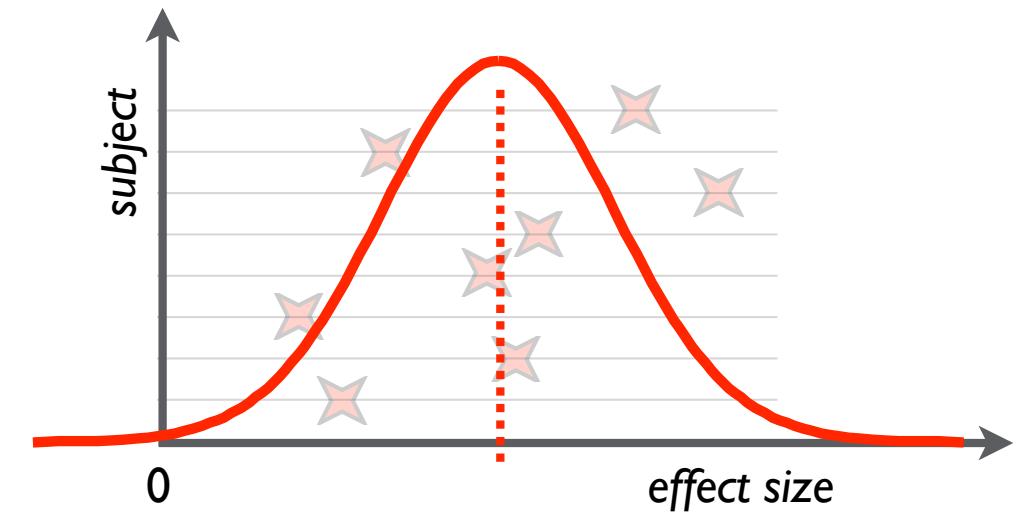
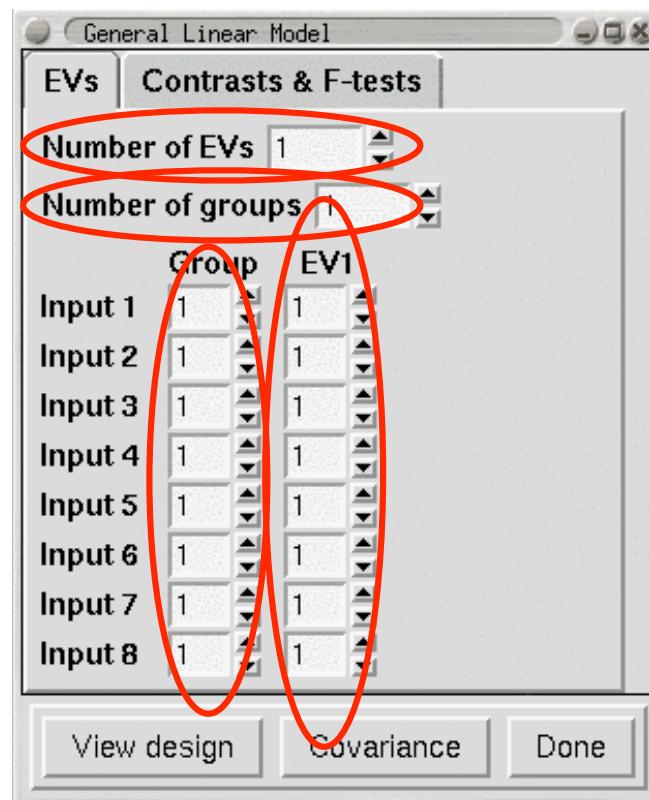




Single Group Average

单组平均值

Does the group activate on average? 组激活是均值吗?





Single Group Average

单组平均值

Does the group activate on average? 组激活是均值吗?

General Linear Model

EVs Contrasts & F-tests

Number of EVs 1

Number of groups 1

Group	EV1
Input 1	1
Input 2	1
Input 3	1
Input 4	1
Input 5	1
Input 6	1
Input 7	1
Input 8	1

View design **Covariance** **Done**

General Linear Model

EVs Contrasts & F-tests

Contrasts 1 F-tests 0

Title	EV1
C1	group mean

View design **Covariance** **Done**

Model

1	
1	
1	
1	
1	
1	
1	
1	
c1	group mean
	1



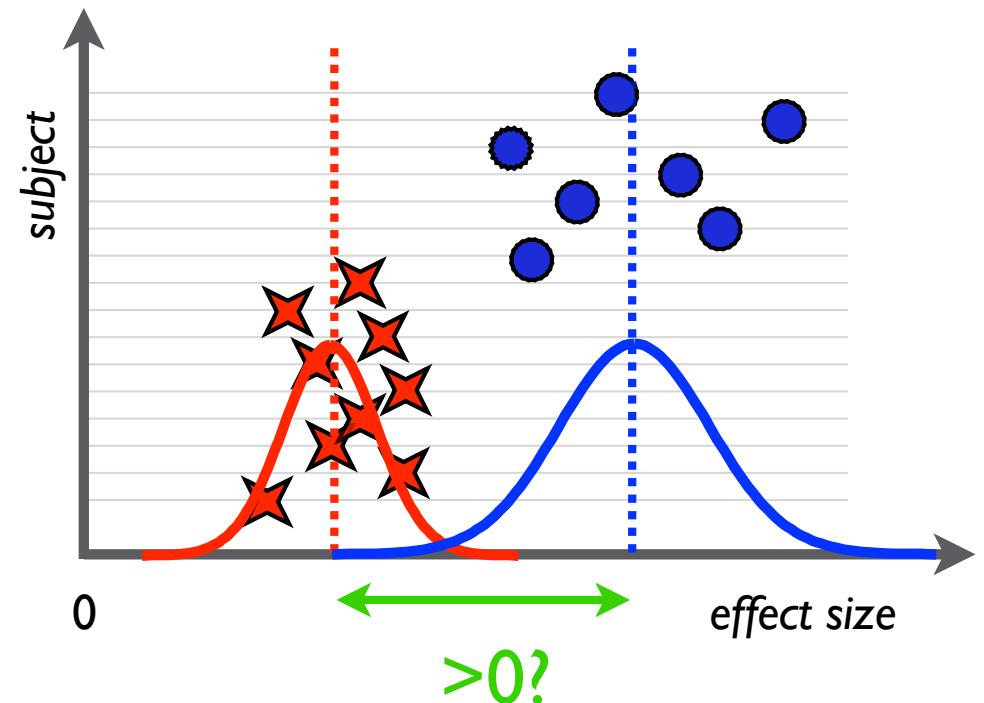
Unpaired Two-Group Difference

非配对的两组差异

- We have two groups (e.g. 9 patients, 7 controls) with different between-subject variance
有两组（9病人，7控制组）组间方差不同

Is there a significant group difference? 组间差异显著吗

- estimate means 估计均值
- estimate std-errors (FE or ME) 估计标准误差
- test significance of difference in means
检测均值差异的显著性

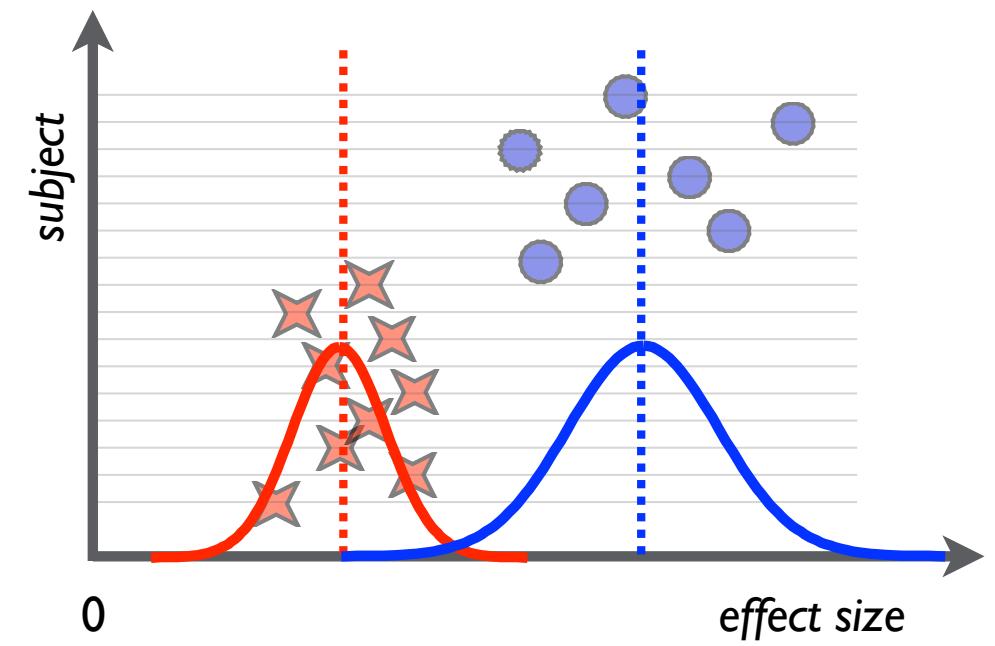
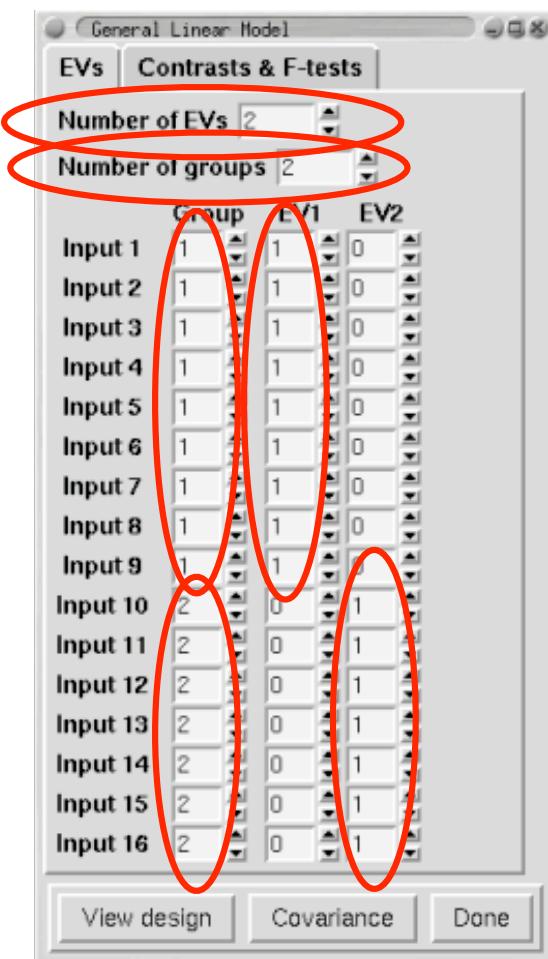




Unpaired Two-Group Difference

非配对的两组差异

Is there a significant group difference? 组间差异显著吗

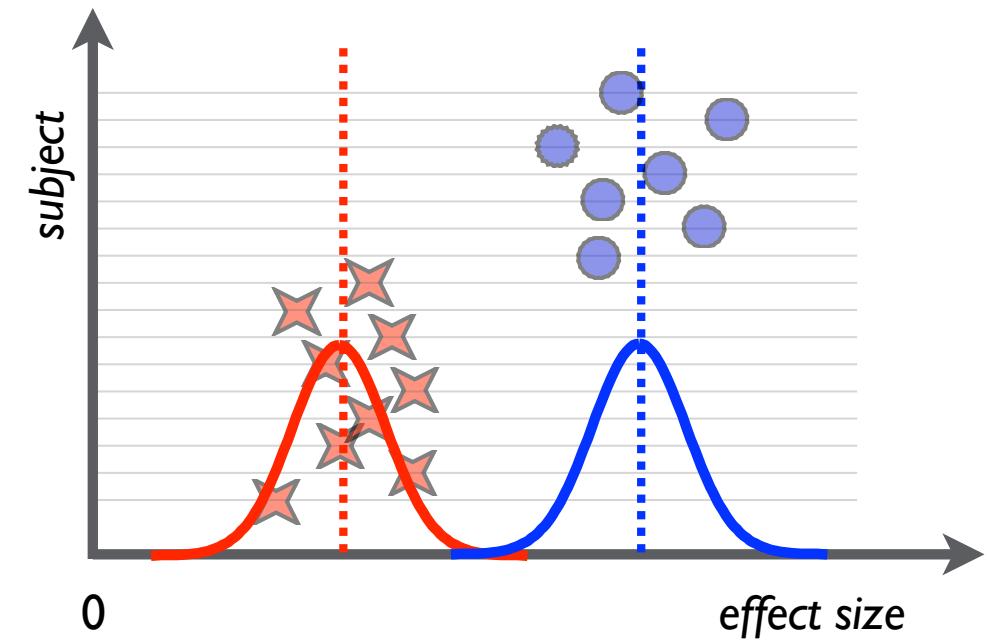
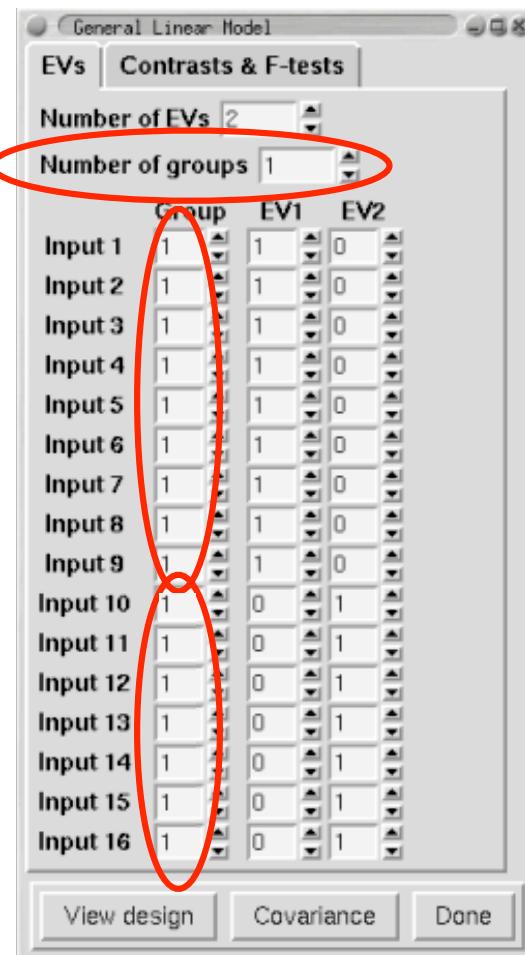




Unpaired Two-Group Difference

非配对的两组差异

Is there a significant group difference? 组间差异显著吗

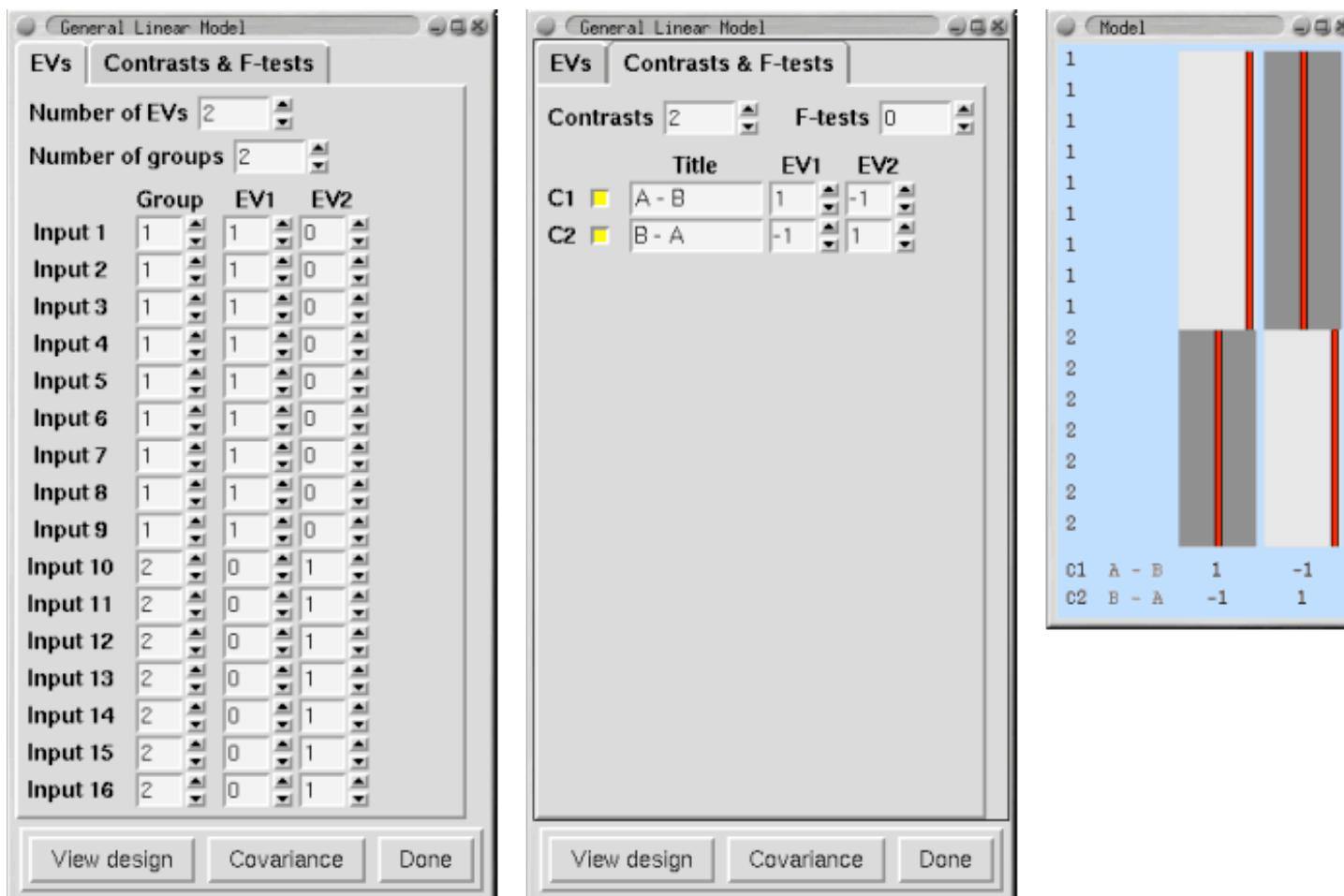




Unpaired Two-Group Difference

非配对的两组差异

Is there a significant group difference? 组间差异显著吗





Paired T-Test

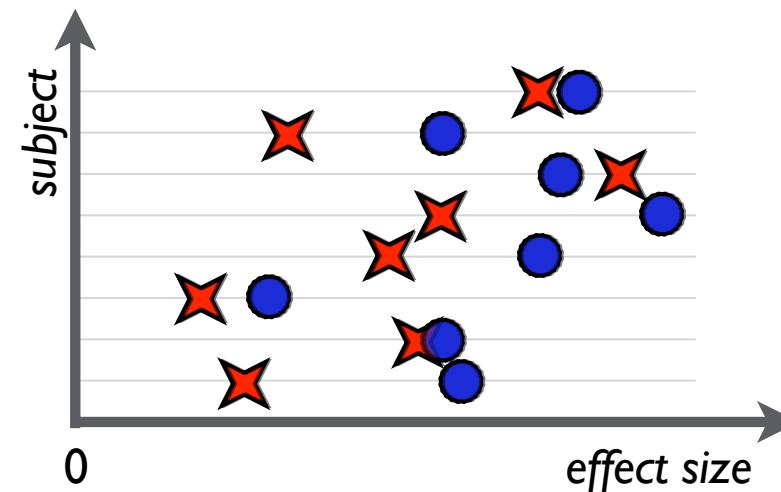
配对T检验

- 8 subjects scanned under 2 conditions (A,B)

8个被试在AB两个条件下进行扫描

Is there a significant difference between conditions?

条件之间差异显著吗?





Paired T-Test

配对T检验

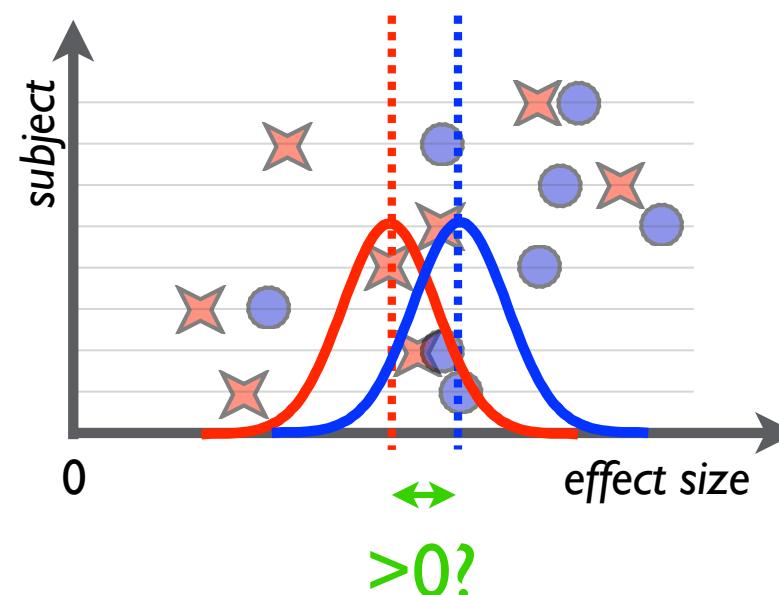
- 8 subjects scanned under 2 conditions (A,B)

8个被试在AB两个条件下进行扫描

Is there a significant difference between conditions?

条件之间差异显著吗？

try non-paired t-test 尝试进行非配对T检验





Paired T-Test

配对T检验

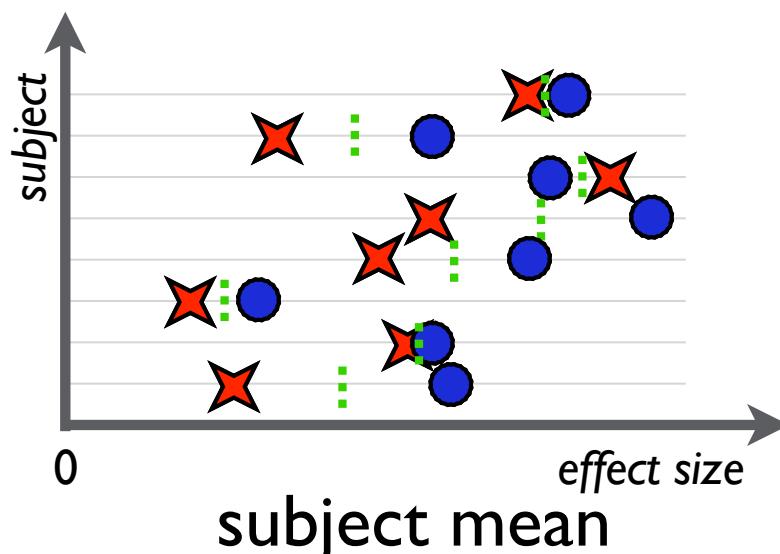
- 8 subjects scanned under 2 conditions (A,B)

8个被试在AB两个条件下进行扫描

Is there a significant difference between conditions?

条件之间差异显著吗？

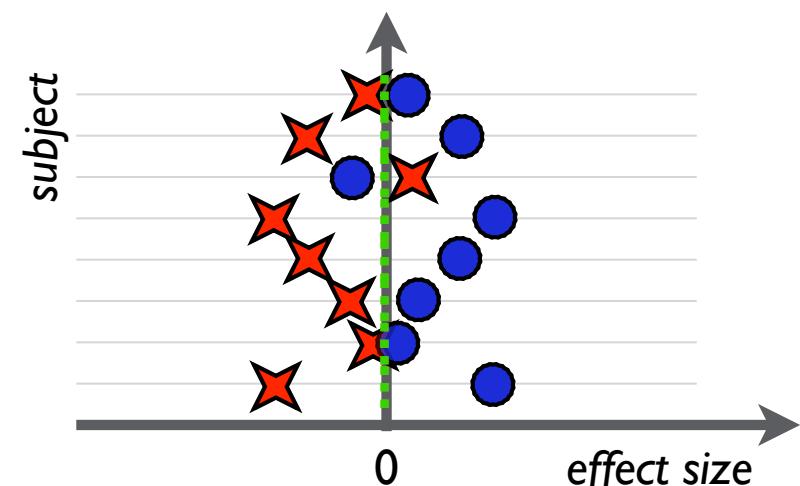
data



subject mean
accounts for large prop.
of the overall variance

个体均值占总体方差的很大比例

de-meanned data 去均值数据





Paired T-Test

配对T检验

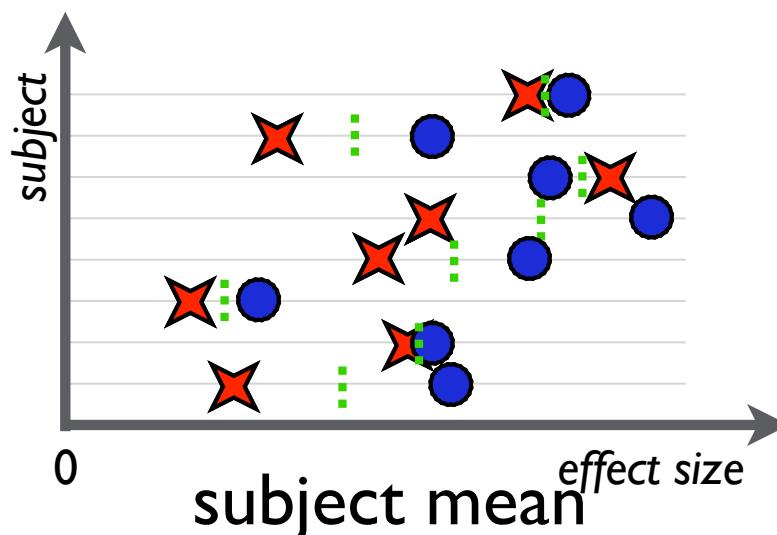
- 8 subjects scanned under 2 conditions (A,B)

8个被试在AB两个条件下进行扫描

Is there a significant difference between conditions?

条件之间差异显著吗？

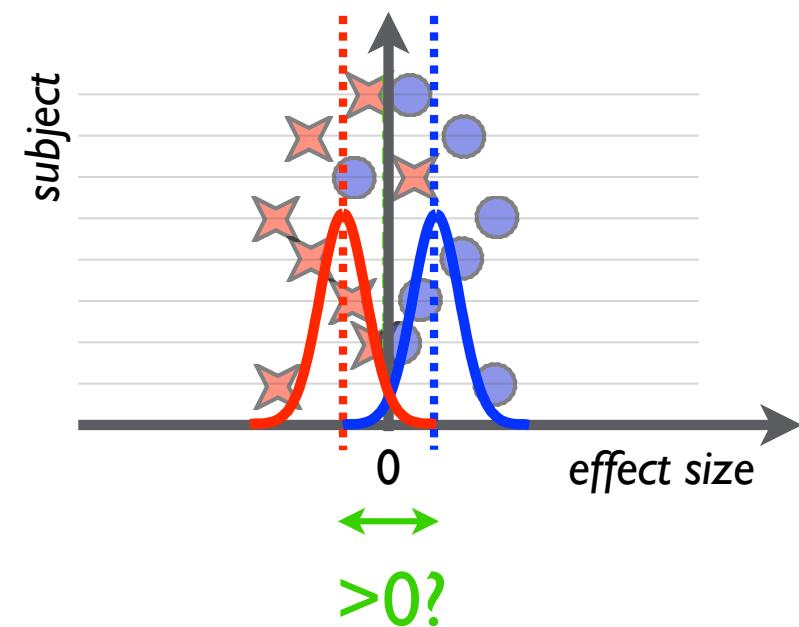
data



accounts for large prop.
of the overall variance

个体均值占总体方差的很大比例

de-meanned data 去均值数据

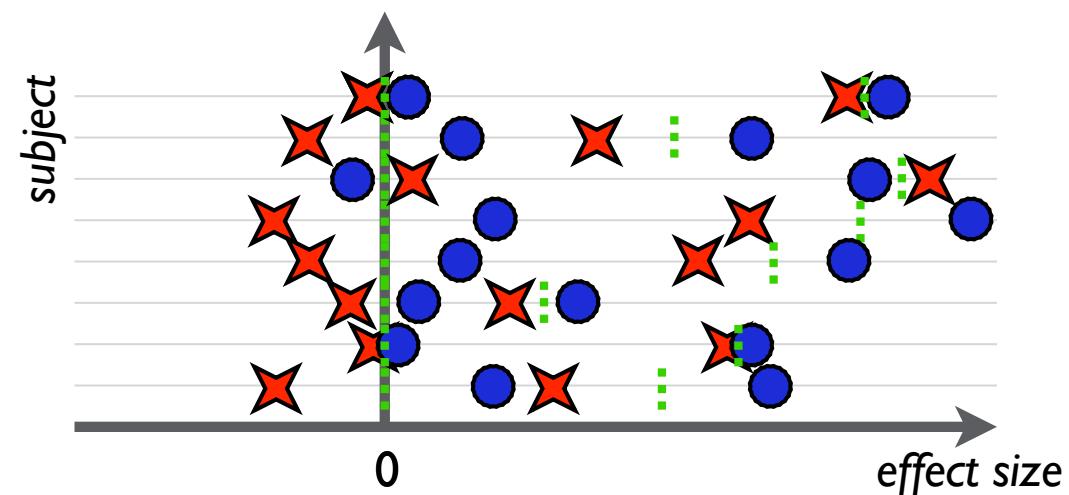
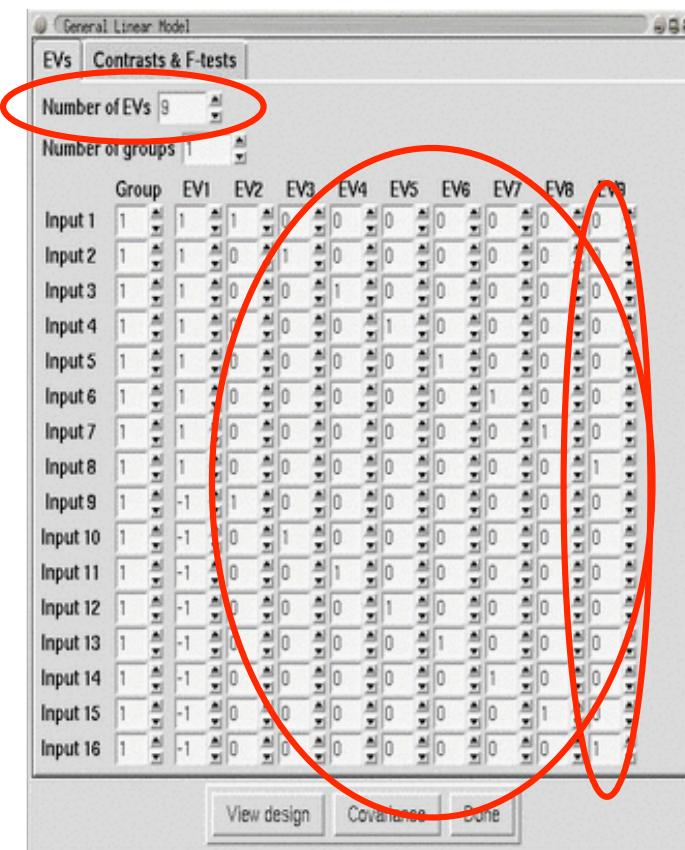




Paired T-Test

配对T检验

Is there a significant difference between conditions?
条件之间差异显著吗?

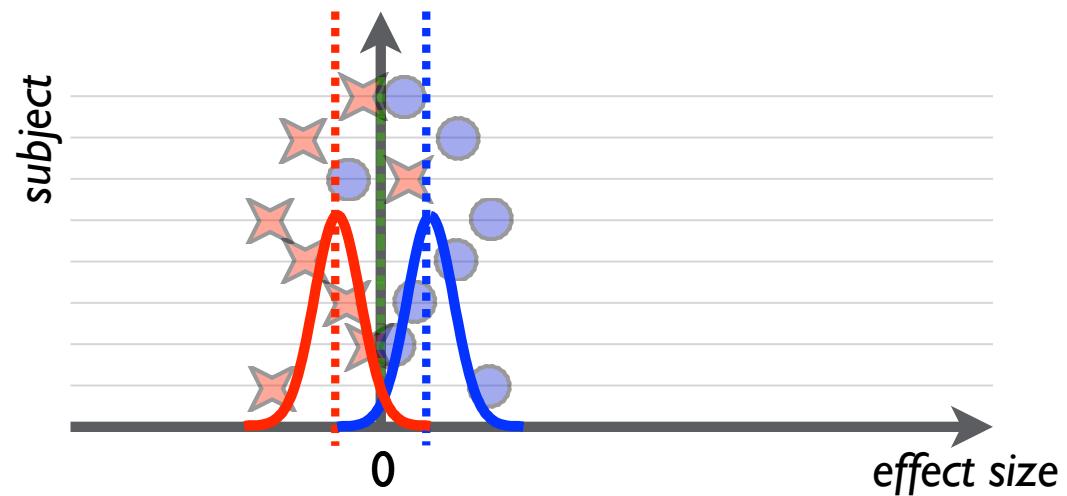
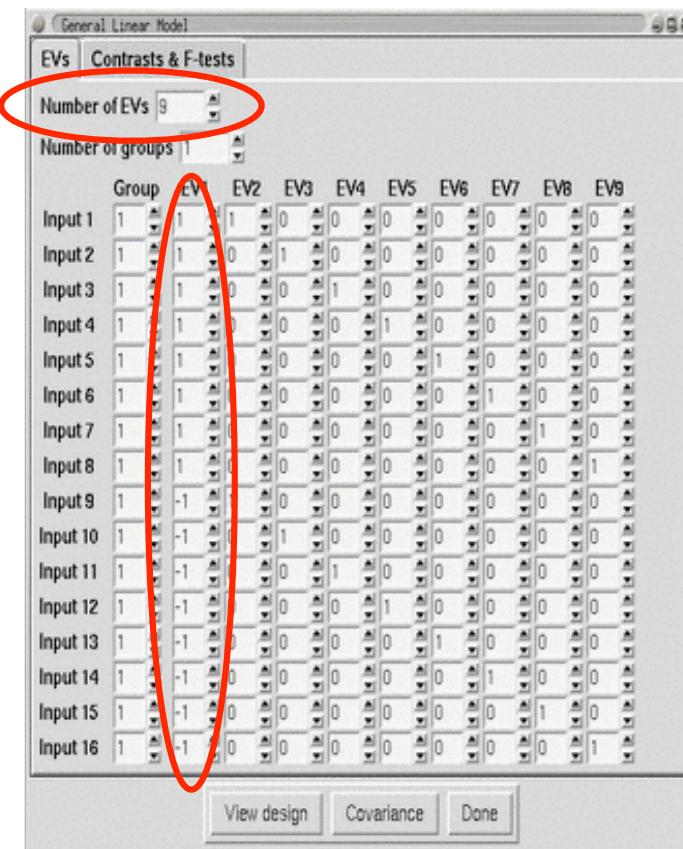




Paired T-Test

配对T检验

Is there a significant difference between conditions?
条件之间差异显著吗?





Paired T-Test

配对T检验

Is there a significant difference between conditions?
条件之间差异显著吗?

	Group	EV1	EV2	EV3	EV4	EV5	EV6	EV7	EV8	EV9
Input 1	1	1	1	0	0	0	0	0	0	0
Input 2	1	1	0	1	0	0	0	0	0	0
Input 3	1	1	0	0	1	0	0	0	0	0
Input 4	1	1	0	0	0	1	0	0	0	0
Input 5	1	1	0	0	0	0	1	0	0	0
Input 6	1	1	0	0	0	0	0	1	0	0
Input 7	1	1	0	0	0	0	0	0	1	0
Input 8	1	1	0	0	0	0	0	0	0	1
Input 9	1	-1	0	0	0	0	0	0	0	0
Input 10	1	-1	0	1	0	0	0	0	0	0
Input 11	1	-1	0	0	1	0	0	0	0	0
Input 12	1	-1	0	0	0	1	0	0	0	0
Input 13	1	-1	0	0	0	0	1	0	0	0
Input 14	1	-1	0	0	0	0	0	1	0	0
Input 15	1	-1	0	0	0	0	0	0	1	0
Input 16	1	-1	0	0	0	0	0	0	0	1

EV1 models the A-B paired difference; EVs 2-9 are confounds which model out each subject's mean

EV1是A-B两配对组的差异建模；
EV 2-9是混淆因素，为每个被试的均值建模



Paired T-Test

配对T检验

Is there a significant difference between conditions?
条件之间差异显著吗?

General Linear Model

EVs Contrasts & F-tests

Number of EVs: 9
Number of groups: 1

Group	EV1	EV2	EV3	EV4	EV5	EV6	EV7	EV8	EV9
Input 1	1	1	0	0	0	0	0	0	0
Input 2	1	0	1	0	0	0	0	0	0
Input 3	1	0	0	1	0	0	0	0	0
Input 4	1	0	0	0	1	0	0	0	0
Input 5	1	0	0	0	0	1	0	0	0
Input 6	1	0	0	0	0	0	1	0	0
Input 7	1	0	0	0	0	0	0	1	0
Input 8	1	0	0	0	0	0	0	0	1
Input 9	1	-1	0	0	0	0	0	0	0
Input 10	1	-1	0	1	0	0	0	0	0
Input 11	1	-1	0	0	1	0	0	0	0
Input 12	1	-1	0	0	0	1	0	0	0
Input 13	1	-1	0	0	0	0	1	0	0
Input 14	1	-1	0	0	0	0	0	1	0
Input 15	1	-1	0	0	0	0	0	0	1
Input 16	1	-1	0	0	0	0	0	0	1

View design **Covariance** **Done**

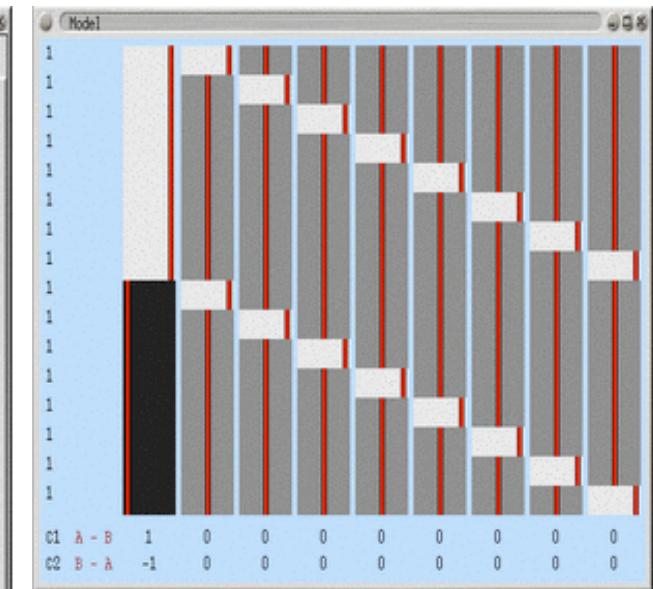
General Linear Model

EVs Contrasts & F-tests

Contrasts: 2 F-tests: 0

Title	EV1	EV2	EV3	EV4	EV5	EV6	EV7	EV8	EV9
C1	A - B	1	0	0	0	0	0	0	0
C2	B - A	-1	0	0	0	0	0	0	0

View design **Covariance** **Done**



Multi-Session & Multi-Subject

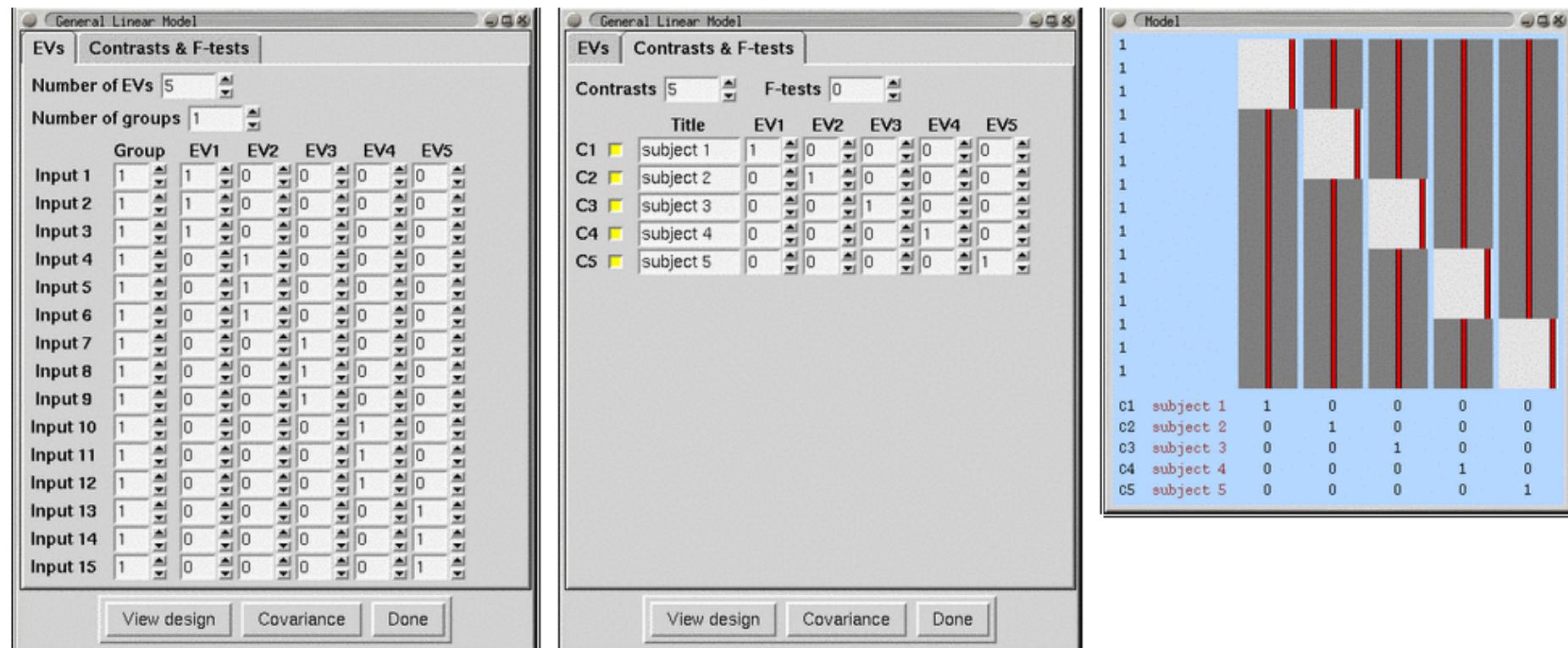
多阶段&多被试

- 5 subjects each have three sessions. 5个被试，每人3阶段

Does the group activate on average? 组激活是平均值吗?

- Use three levels: in the **second level** we model the within-subject repeated measure

使用三个水平：在第二水平中，我们对被试内重复测量进行建模





Multi-Session & Multi-Subject

多阶段&多被试

- 5 subjects each have three sessions. 5个被试，每人3阶段

Does the group activate on average? 组激活是平均值吗？

- Use three levels: in the **third level** we model the between-subjects variance 在第三水平对被试间变异建模

The figure displays three windows from a statistical software, likely SPSS, illustrating the setup of a General Linear Model (GLM) for a multi-session, multi-subject design.

- Left Window (General Linear Model - EVs tab):** Shows the specification of the model structure. It includes fields for "Number of EVs" (set to 1), "Number of groups" (set to 1), and a data grid for "Input 1" through "Input 5". The grid has two columns: "Group" and "EV1", both containing the value 1. At the bottom are buttons for "View design", "Covariance", and "Done".
- Middle Window (General Linear Model - Contrasts & F-tests tab):** Shows the specification of contrasts. It includes fields for "Contrasts" (set to 1) and "F-tests" (set to 0). A table row is selected, labeled "C1" with a yellow highlight, and the "Title" field contains "group mean". The "EV1" field shows the value 1. At the bottom are buttons for "View design", "Covariance", and "Done".
- Right Window (Model tab):** Shows the resulting model matrix. The matrix has 5 rows (Input 1 to Input 5) and 2 columns. The first column contains the value 1 for all rows. The second column contains the value 1 for the first four rows and the value 0 for the fifth row. Below the matrix, the row "C1 group mean" is highlighted in red, corresponding to the selected contrast in the middle window. The number 1 is also highlighted in red at the far right of the second column.



Multi-Session & Multi-Subject

多阶段&多被试

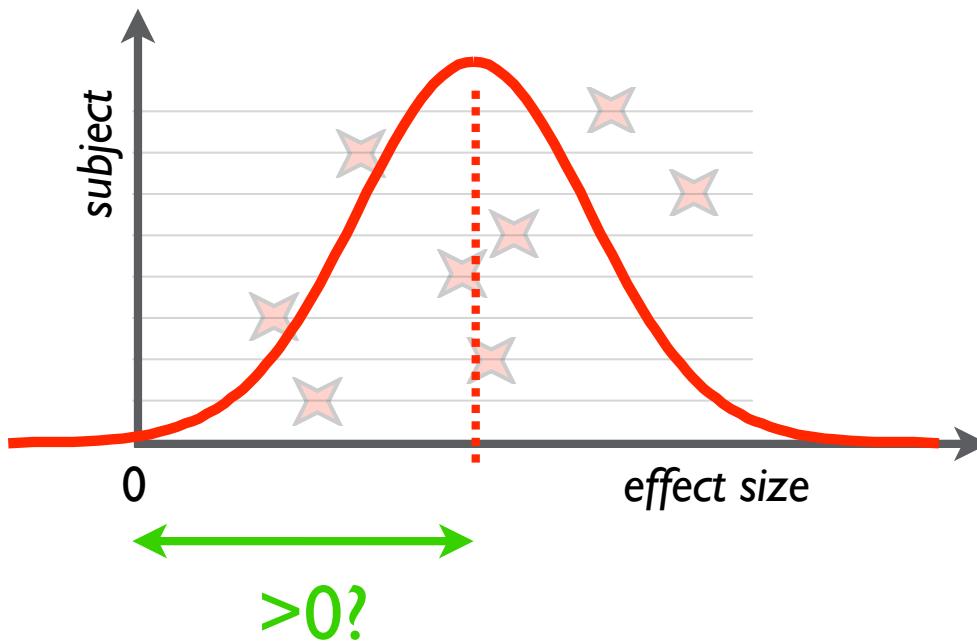
- 5 subjects each have three sessions. 5个被试，每人3阶段
Does the group activate on average? 组激活是平均值吗?
- Use three levels:
 - in the second level we model the within subject repeated measure typically using **fixed effects(!)** as #sessions are small
在第二水平中，由于每阶段较小，我们通常使用固定效应对被试内的重复测量进行建模
 - in the third level we model the between subjects variance using fixed or mixed effects
在第三水平使用固定效应或混合效应对被试间差异进行建模



Reducing variance

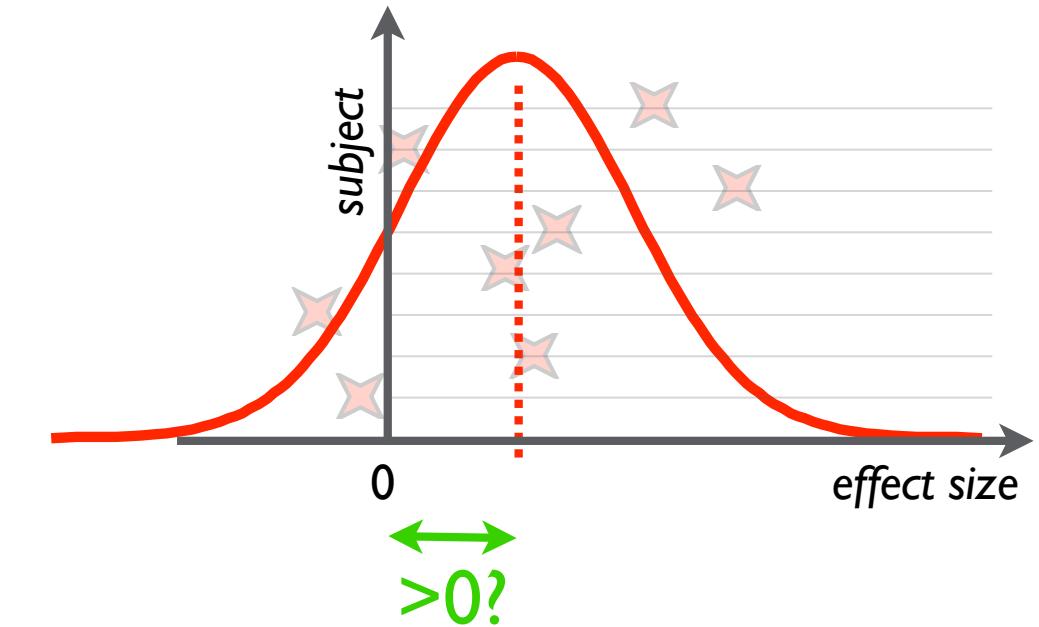
减少方差

Does the group activate on average? 组激活是平均值吗?



**mean effect size large
relative to std error**

相对于标准误，平均效应量较大



**mean effect size small
relative to std error**

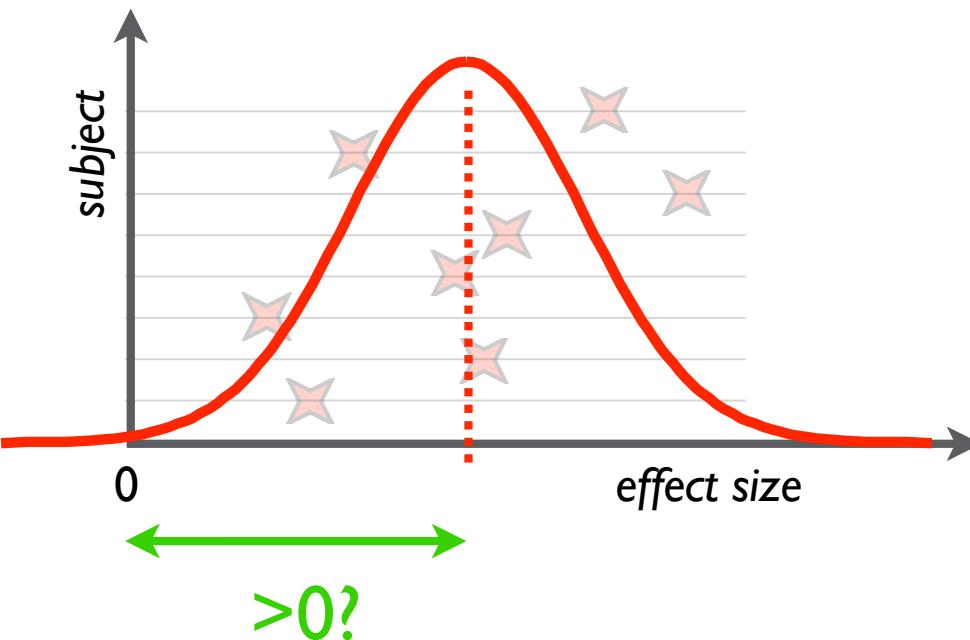
相对于标准误，平均效应量较小



Reducing variance

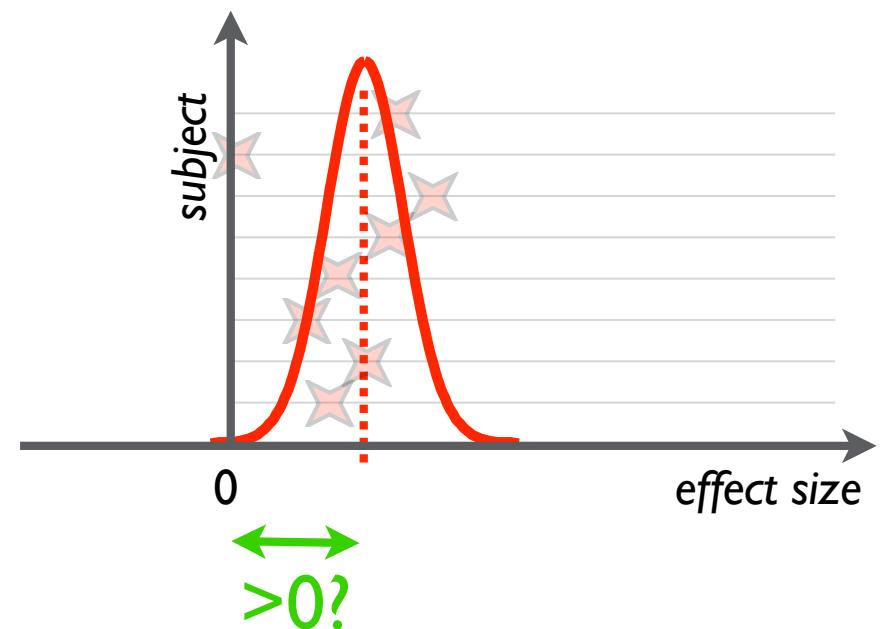
减少方差

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**mean effect size large
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**mean effect size small
relative to std error**

相对于标准误，平均效应量较小



Single Group Average & Covariates

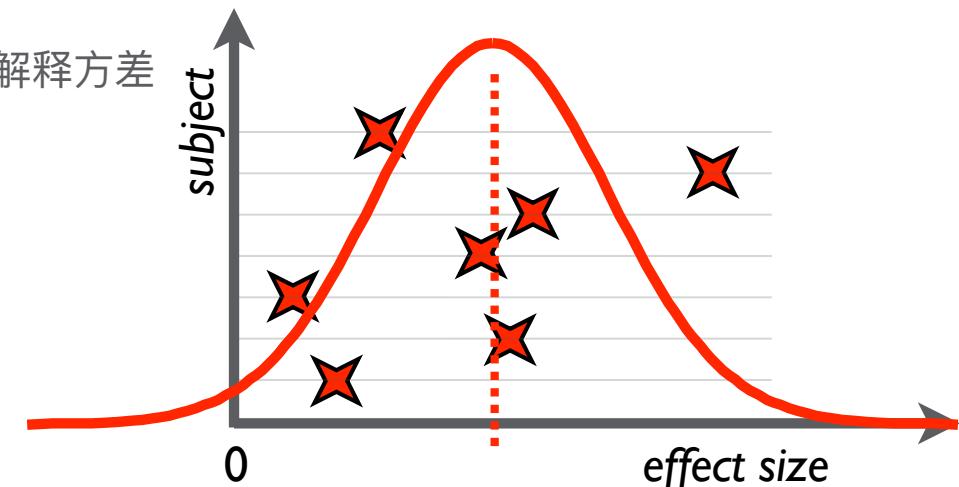
单组平均值和协变量

- We have 7 subjects - all in one group. We also have additional measurements (e.g. age; disability score; behavioural measures like reaction times):

一组有7个被试，并且提供其他指标（例如年龄，残疾评分，行为指标（例如反应时间））

Does the group activate on average? 组激活是平均值吗？

- use covariates to
'explain' variation 用协变量解释方差
- estimate mean 估计均值
- estimate std-error
(FE or ME) 估计标准误





Single Group Average & Covariates

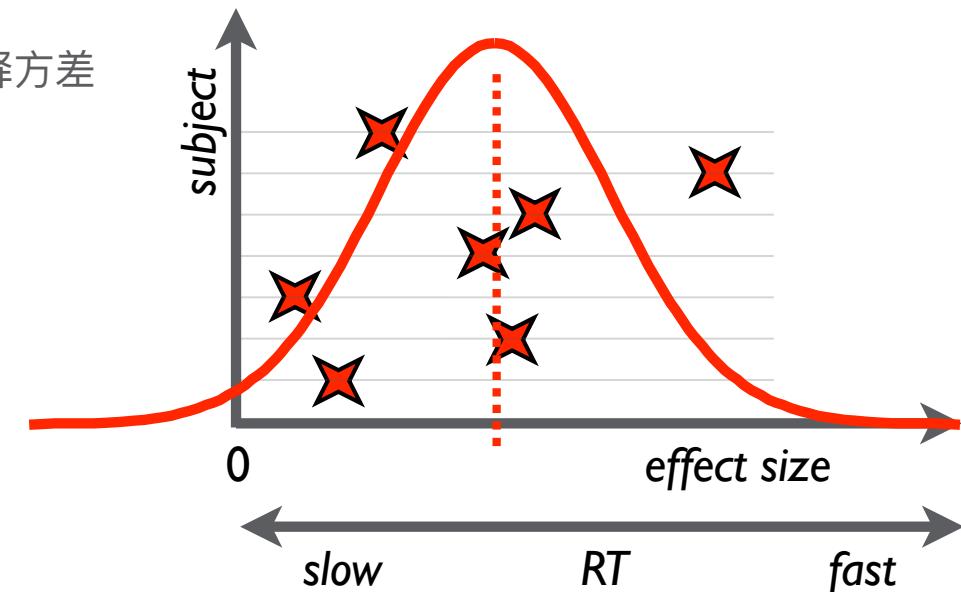
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- estimate mean 估计均值
- estimate std-error (FE or ME) 估计标准误

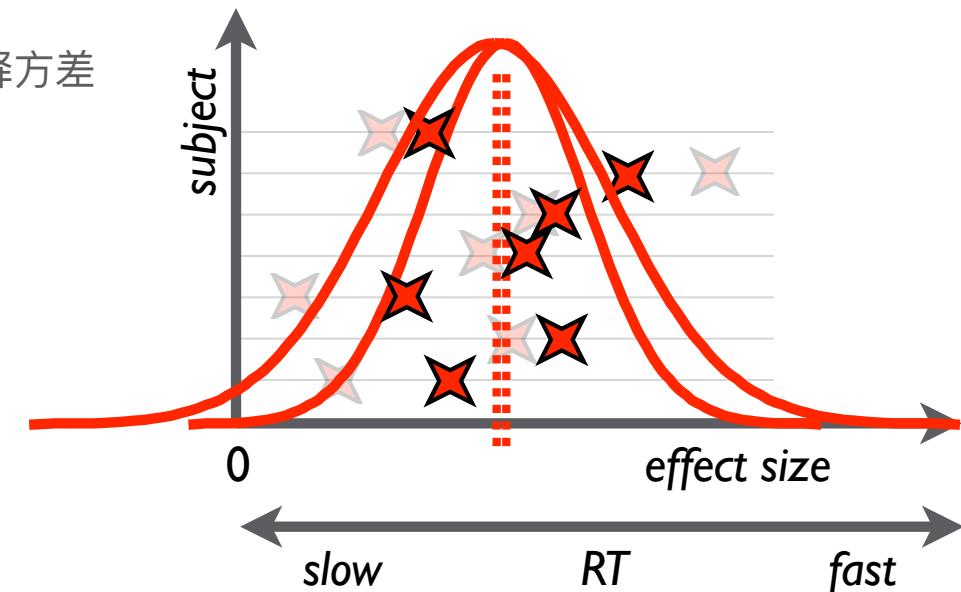




Single Group Average & Covariates

单组平均值和协变量

- We have 7 subjects - all in one group. We also have additional measurements (e.g. age; disability score; behavioural measures like reaction times):
一组有7个被试，并且提供其他指标（例如年龄，残疾评分，行为指标（例如反应时间））
- Does the group activate on average? 组激活是平均值吗?
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(FE or ME) 估计标准误





Single Group Average & Covariates

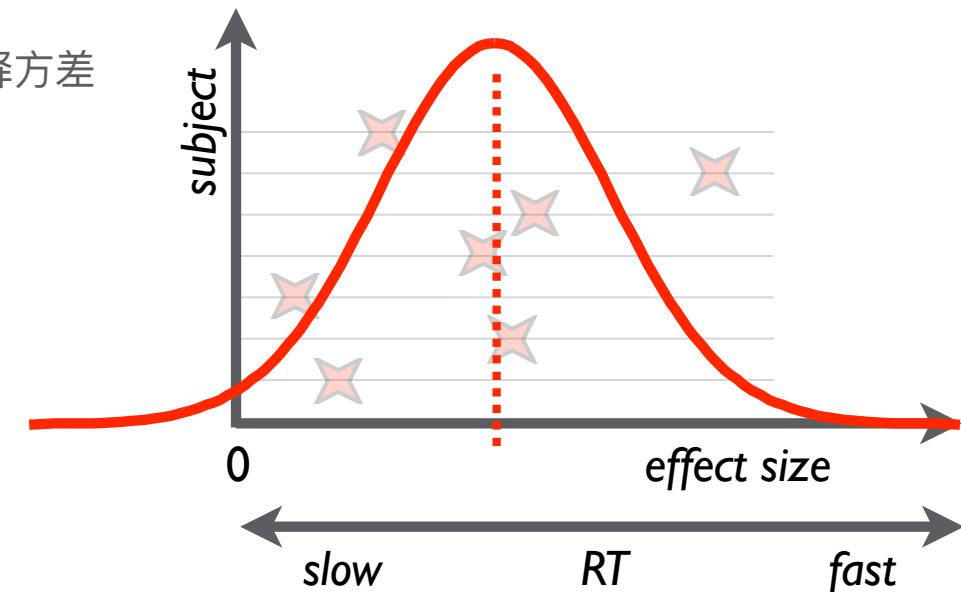
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一组有7个被试，并且提供其他指标（例如年龄，残疾评分，行为指标（例如反应时间））

Does the group activate on average? 组激活是平均值吗？

- use covariates to ‘explain’ variation 用协变量解释方差
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- estimate std-error (FE or ME) 估计标准误





Single Group Average & Covariates

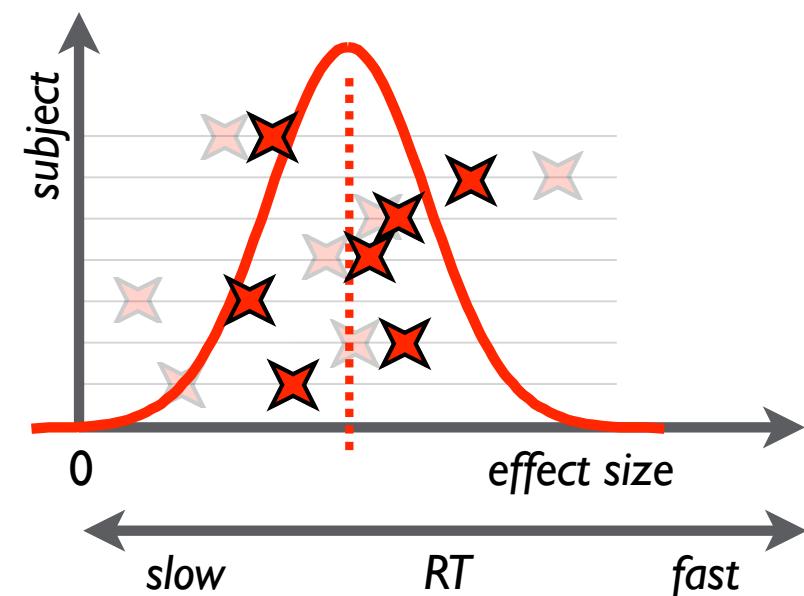
单组平均值和协变量

- We have 7 subjects - all in one group. We also have additional measurements (e.g. age; disability score; behavioural measures like reaction times):

一组有7个被试，并且提供其他指标（例如年龄，残疾评分，行为指标（例如反应时间））

Does the group activate on average? 组激活是平均值吗？

- use covariates to ‘explain’ variation 用协变量解释方差
- estimate mean 估计均值
- estimate std-error (FE or ME) 估计标准误





Single Group Average & Covariates

单组平均值和协变量

Does the group activate on average? 组激活是平均值吗?

- use covariates to ‘explain’ variation 用协变量解释方差
- need to de-mean additional covariates!
需要为额外的协变量去均值!

General Linear Model

EVs Contrasts & F-tests

Number of EVs: 2

Number of groups: 1

	Group	EV1	EV2
Input 1	1	1	24
Input 2	1	1	-18
Input 3	1	1	-7
Input 4	1	1	5
Input 5	1	1	-4
Input 6	1	1	6
Input 7	1	1	-6

View design Covariance Done

General Linear Model

EVs Contrasts & F-tests

Contrasts: 2 F-tests: 0

Title	EV1	EV2
C1 group mean	1	0
C2 reaction time	0	1

View design Covariance Done

Model

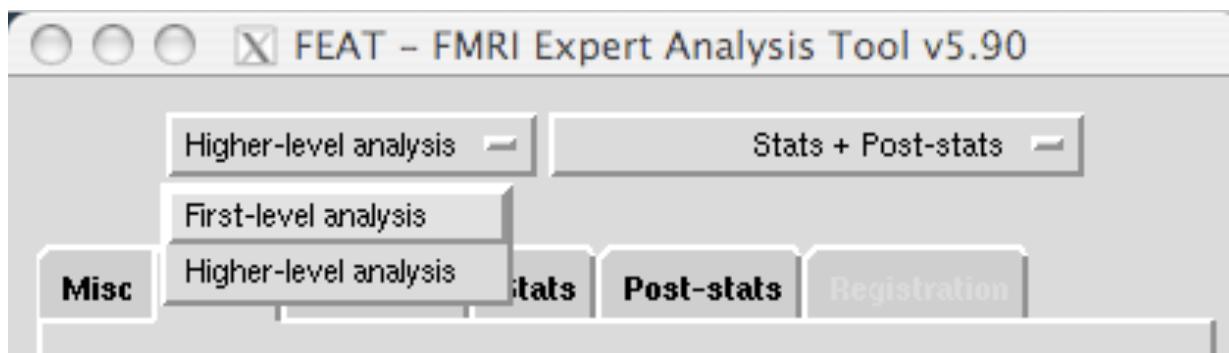
1			
1			
1			
1			
1			
1			
1			
0	group mean	1	0
1	reaction time	0	1



FEAT Group Analysis

FEAT组分析

- Run FEAT on raw FMRI data to get first-level .feat directories, each one with several (**consistent**) COPEs
对原始FMRI数据运行FEAT以获取第一级.feat目录，每个目录均包含多个（一致的）COPE



- low-res copeN/varcopeN → .feat/stats**
低分辨率 contrastN 的参数估计值对比图像 /contrastN 的方差图像 在.feat/stats文件夹下
- when higher-level FEAT is run, highres copeN/ varcopeN → .feat/reg_standard**
当高水平FEAT运行时，高分辨率contrastN的参数估计值对比图像 /contrastN的方差图像在.feat/reg_standard文件夹下



FEAT Group Analysis

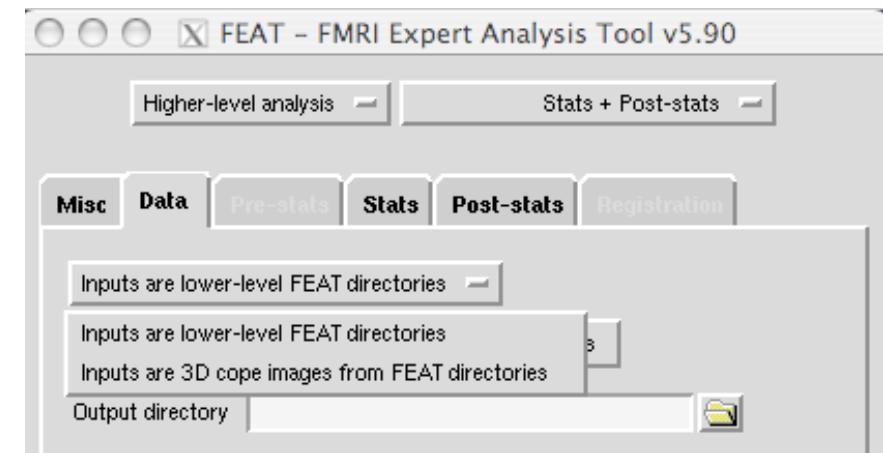
FEAT组分析

- Run second-level FEAT to get one .gfeat directory

运行第二水平FEAT可以得到一个.gfeat文件夹

- Inputs can be lower-level .feat dirs or lower-level COPEs

可以输入低水平的.feat文件夹
或者低水平的COPE文件



- the second-level GLM analysis is run separately for each first-level COPE

别对每个第一水平的COPE图像运行第二水平的GLM分析

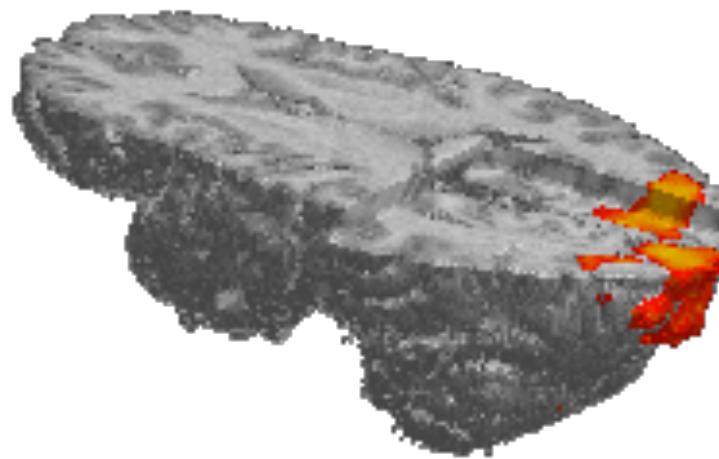
分

- each lower-level COPE generates its own .feat directory inside the .gfeat dir

每个低水平的COPE可以在.gfeat文件夹下生成一个单独的.feat文件夹



That's all folks





Appendix:



Group F-tests

组水平F检验

- 3 groups of subjects 3组被试

Is any of the groups activating on average? 是否有组平均激活?

General Linear Model

EVs | Contrasts & F-tests

Number of EVs: 3

Number of groups: 3

	Group	EV1	EV2	EV3
Input 1	1	1	0	0
Input 2	1	1	0	0
Input 3	1	1	0	0
Input 4	1	1	0	0
Input 5	1	1	0	0
Input 6	2	0	1	0
Input 7	2	0	1	0
Input 8	2	0	1	0
Input 9	2	0	1	0
Input 10	2	0	1	0
Input 11	3	0	0	1
Input 12	3	0	0	1
Input 13	3	0	0	1
Input 14	3	0	0	1
Input 15	3	0	0	1

View design | Covariance | Done

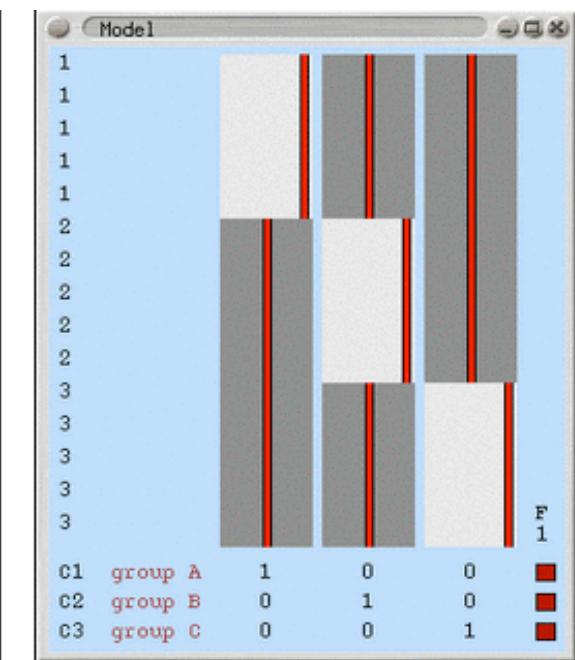
General Linear Model

EVs | Contrasts & F-tests

Contrasts: 3 F-tests: 1

Title	EV1	EV2	EV3	F1
C1 group A	1	0	0	■
C2 group B	0	1	0	■
C3 group C	0	0	1	■

View design | Covariance | Done





ANOVA: I-factor 4-levels

单因素4水平方差分析

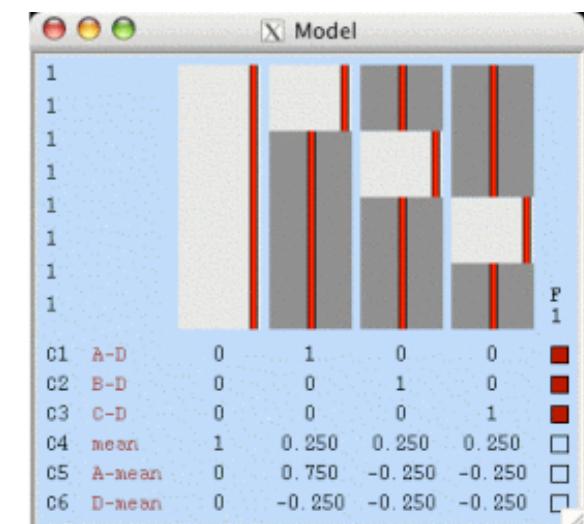
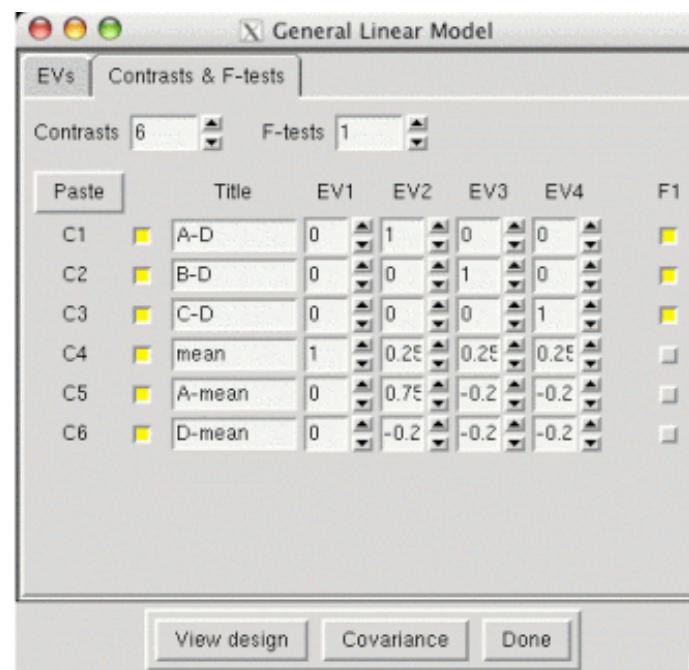
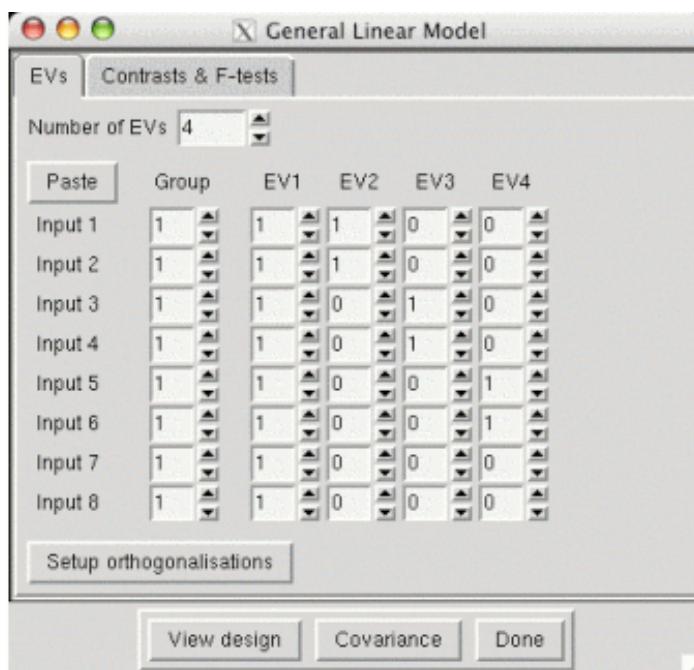
- 8 subjects, I factor at 4 levels

8个被试，单因素4水平

Is there any effect? 是否存在什么效应?

- EV1 fits cond. D, EV2 fits cond A relative to D etc.

EV1拟合条件D, EV2拟合条件A相对于D的差异等



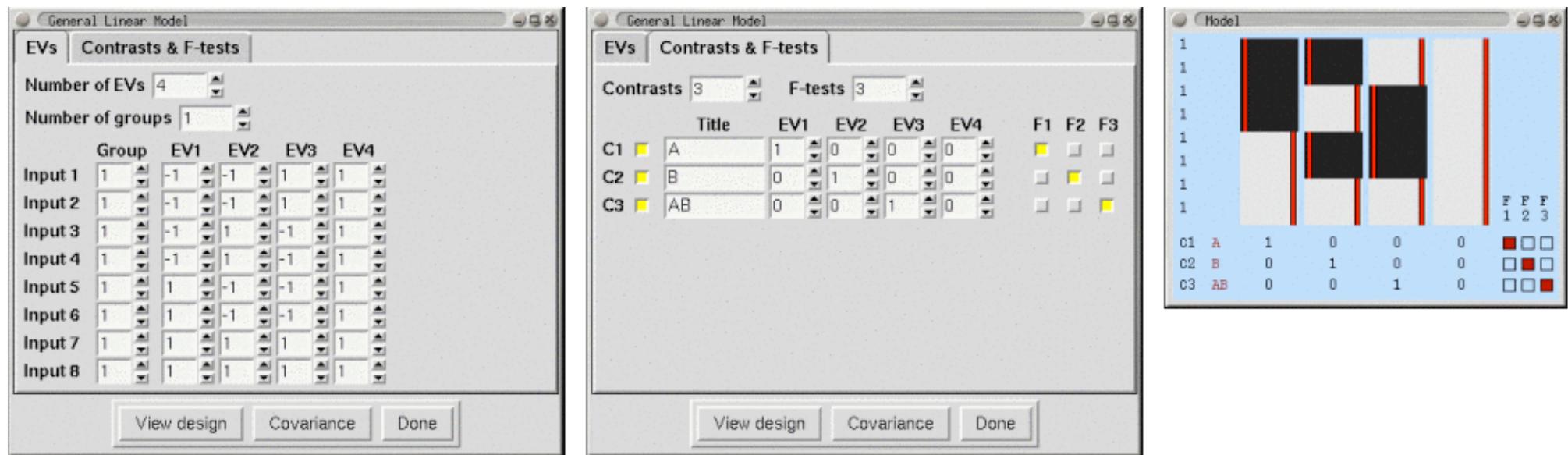


ANOVA: 2-factor 2-levels

2因素2水平方差分析

- 8 subjects, 2 factor at 2 levels. FE Anova: 3 F-tests give standard results for factor A, B and interaction

8个被试，2因素2水平。运行3次F检验可得到因素A,B以及交互作用的标准结果



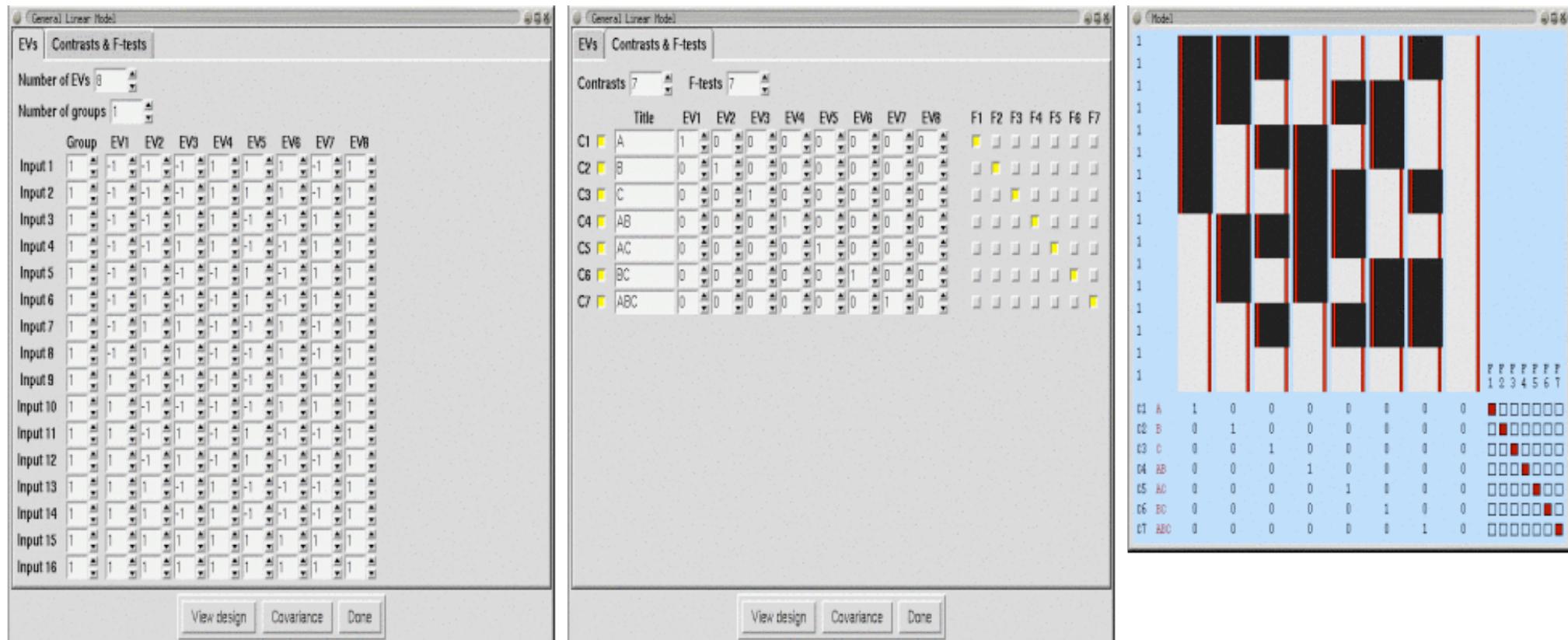
- If both factors are random effects then $F_a = f_{stat1}/f_{stat3}$, $F_b = f_{stat2}/f_{stat3}$. 如果两个因素都有随机效应，则 $F_a = f_{stat1}/f_{stat3}, F_b = f_{stat2}/f_{stat3}$
- ME: if fixed fact. is A, $F_a = f_{stat1}/f_{stat3}$
如果固定效应是A，那么 $F_a = f_{stat1}/f_{stat3}$



ANOVA: 3-factor 2-levels

3因素2水平方差分析

- 16 subjects, 3 factor at 2 levels. 16个被试，3因素2水平
- Fixed-Effects ANOVA: 固定效应方差分析：



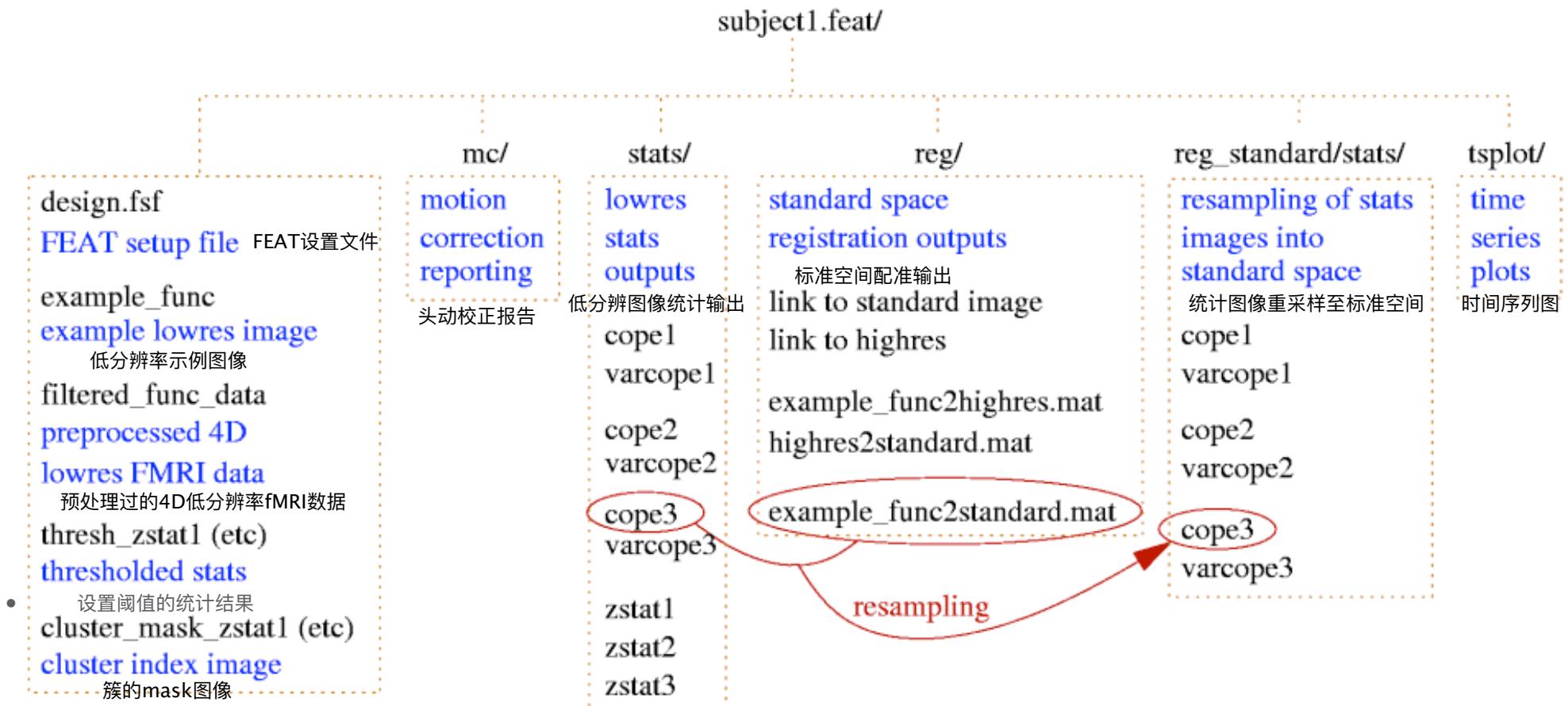
- For random/mixed effects need different Fs.
随机/混合效应需要不同的Fs



Understanding FEAT dirs

理解FEAT文件夹

- First-level analysis: 第一水平分析

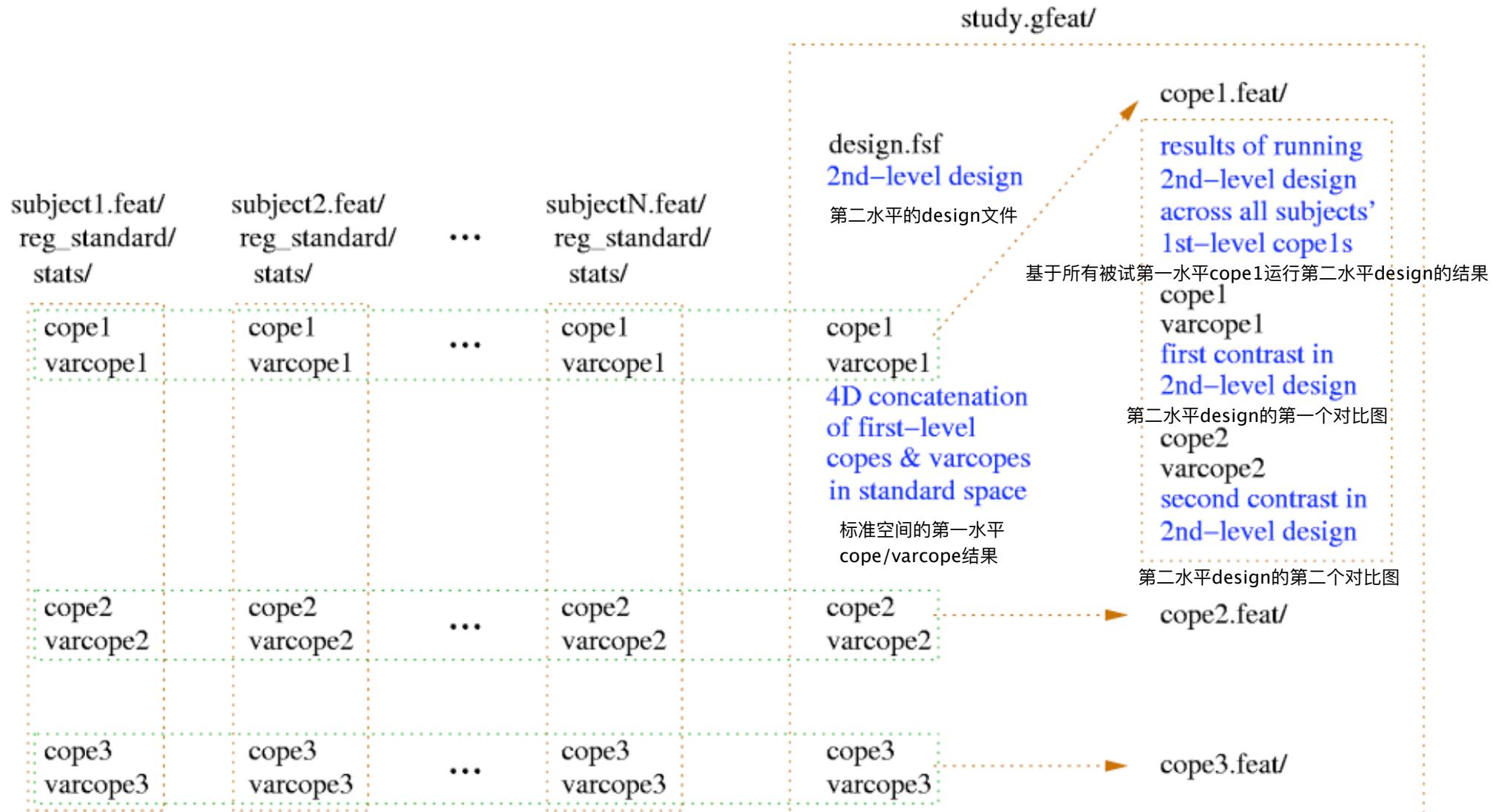




Understanding FEAT dirs

理解FEAT文件夹

- Second-level analysis:





That's all folks

