Power Calculations for fMRI Studies

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Outline

What is a power analysis?
Why/When do we need one?
How are they calculated
Behavioral data
Existing fMRI data

Power calculation...

Determines power of detecting an effect if an effect is present; the probability you will be able to reject the null hypothesis if it is false (avoid a Type II error).

Why/When do we need it?

- Why: To determine the sample size required to observe the hypothesized effect
- When planning a new studyWhen submitting a grant

How to calculate for fMRI: general guidelines

- δ = (μ_D 0) / σ
- Effect size: $\boldsymbol{\delta}$
- Expected difference in means (e.g., task A task B; in % signal change): μ_D
- Difference in under the null hypothesis: 0
- Expected variability in the mean differences (in % signal change): σ

Special consideration

- σ has 2 components in group fMRI studies (at least)
 - σ_{W} : noise within a scan (e.g., thermal noise)
 - σ_B : between-subject variability (e.g., level of attention, motivation, etc.)
 - ALSO...? Between scan variability for multi-run experiments?

How to calculate for fMRI: from behavioral data

- You found an effect in a pilot study
- Want to follow up with an fMRI study
- Have significant results in the form of:
 - t-tests: use the effect and sample sizes OR group/task means and SDs
 - F-tests: **use the** effect size, # groups, correlation among measures, # of measures, nonsphericity correction (epsilon)
- I like G*Power for power calculations (free and allows you to input effect sizes from SPSS): http://www.psycho.uni-duesseldorf.de/ abteilungen/aap/gpower3/

How to calculate for fMRI: from specific region ROIs

- You have data from an fMRI pilot study or previous study
 - Extract signal change values from ROI
 - Run t or F tests to get power calculation parameters

How to calculate for fMRI: from specific ROIs, alternate approach

- Download fMRIpower (Mumford's program from UCLA)
 - http://www.fmripower.org/
 - Need Matlab and SPM
 - Previous analysis in SPM or FSL
 - Extract signal change values from specific anatomical regions (see instruction PDF on the website)

Other considerations

- You don't have data: conduct power calculations based on stats from published papers or contact researchers for required parameters (e.g., effect sizes)
 - This 2nd option, maybe only if you know them personally
- Your calculated power is too low and you can't increase the sample size (e.g., cost or time prohibitive): consider other options that will improve power from previous methods
 - 32-ch coil vs. 12-ch coil
 - Block design vs. event-related design
 - More trials

And as JC would say...

Good luck with your studies! ③