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 study
- When submitting a grant
How to calculate for fMRI: general guidelines

\[ \delta = \frac{(\mu_D - 0)}{\sigma} \]

- Effect size: \( \delta \)
- Expected difference in means (e.g., task A – task B; in % signal change): \( \mu_D \)
- Difference in under the null hypothesis: \( 0 \)
- Expected variability in the mean differences (in % signal change): \( \sigma \)
Special consideration

- \( \sigma \) has 2 components in group fMRI studies (at least)
  - \( \sigma_W \): noise within a scan (e.g., thermal noise)
  - \( \sigma_B \): 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! 😊