Neuropower: a toolbox for fMRI sample size and power calculations.

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Introduction

There is increasing concern about statistical power in neuroscience research: an underpowered study has poor predictive power (Ioannidis, 2005). ⇒ A power analysis is a critical component of any study.

We presented a simple way to characterize the spatial signal in an fMRI study, and a direct way to estimate power based on an existing pilot study in Durnez et al. (2016).

Neuropower is a web application with the power estimation procedure.

Power estimation procedure

- We estimate \(\pi_1\), proportion of peak \(p\)-values that are non-null, from peaks and their uncorrected \(p\)-values in a group level analysis.
- Assuming an exponential null distribution for peak values (Friston, 2007) and a truncated normal distribution (truncation at excursion threshold \(u\)) for the alternative distribution, the distribution of peak values can be written as a mixture:

\[
f(z | \pi_0, \mu_1, \sigma_1, u) = (1 - \pi_1) \exp(-u(z - u)) + \pi_1 \Phi\left(\frac{z - \mu_1}{\sigma_1}\right)
\]

\(\pi_1\) and \(\sigma_1\) are estimated using maximum likelihood, where \(\mu_1\) is the expected peak height in activated regions. Power can be estimated for a given threshold \(t\) as \(P(T > t | H_a)\) with \(T\) the \(T\)-statistic of the peak.

Validation in Durnez et al. (2016): extensive validation for multiple effect heights, sizes, significance testing procedures on simulated and real data.

Power interpretation: ‘the average probability that a peak will surpass the significance threshold’

www.neuropowertools.org

1. Input

- Pilot data
  - Pilot data of new experiment
  - Data with comparable experimental design, for example from www.neurovault.org
  - Previous experiment
  - See 2220 about interim analysis.
- Mask (optional)
- Design parameters

2. Viewer

3. Peak extraction

4. Model estimation

5. Power predictions

- Interactive power predictions for different significance testing procedures.
- Example data: reading scrambled vs. letter strings (Moberget et al., 2015). Statistical map obtained from www.neurovault.org

Extra’s

- Integrated with neurovault.org
- pypi-package: neuropower
- Future plans:
  - Export report + code
  - Include interim analysis, see 2220
  - Cluster based power

Stats on June 27, 2016

- released: April 18, 2016
- unique visitors: 1021
- power analyses: 67

References


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