Effect Sizes in Task-Based Functional Magnetic Resonance Imaging

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Effect Sizes in Task-Based Functional Magnetic Resonance Imaging

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Background
- There are many ways to divide the cerebral cortex in order to determine which areas are responsible for certain behaviors.
- Main goal of this research was to find the most precise way to divide the cortex for investigating behavioral tasks in functional-MRI research.
- Task-based fMRI measures blood oxygen level in 3D pixels known as voxels.
- Voxels can be grouped and measured in different ways.
- Focused on the difference between regions of interest and parcellation.

Working Memory Task
- Focused on working memory.
- Task was 2-back > 0-back.
- Participants asked to indicate when stimulus is same as 2 previous.
- Working memory is more active during 2-back.

Previous Research
- Used region of interest (ROI).
- Investigated working memory in middle frontal gyrus (MFG).
  - Used meta-analysis of previous studies to create a region of interest.
  - This ROI consisted of 7116 voxels.
- Used the same 2 > 0 task.
- Sample of 186 participants from Human Connectome Project.

Parcellation
- New method of dividing the cortex into 330 parcels.
  - Average of 130 voxels per parcel (54x smaller than ROI # of voxels).
  - Uses abrupt transitions in resting-state functional connectivity to create parcels.

Procedure
- Effect size = difference between working memory activation (2-back > 0-back) / standard deviation.
- We analyzed parcels individually and as whole networks that overlapped the MFG.
  1. Cingulo-opercular (CON)
  2. Dorsal attention (DAN)
  3. Fronto-parietal (FPN)
  4. Ventral attention (VAN)
- Same 186 subjects as previous research.

Results
- Dashed line = effect size of 0.5 from previous research.
- Dotted line = effect size of 0.8 (large effect size)
- Yellow line = average effect size for each network.

Conclusion
- New method of dividing the cortex = more precise effect sizes.
  - Allows for a more “fine grain” analysis of brain activity.
  - Used the same participants and working memory task; thus change in effect sizes are due to parcellation.
  - Found effect sizes ranging from -1 to 1.7 for individual parcels.

Future Research
- Investigate other tasks, behaviors, and networks.
- Use all 1200 participants from HCP.
- Look for a correlation between effect size and parcel size.
- This was an exploratory study and creates possibilities for hypothesis generation in future studies.
  - Creates possibility for hypothesis generation in future studies.

Found average effect size of 0.5 for working memory in MFG.

Dashed line represents effect size of 0.5 from previous research.