

SPM8 for Basic and Clinical Investigators

Functional MRI Data Acquisition: Temporal

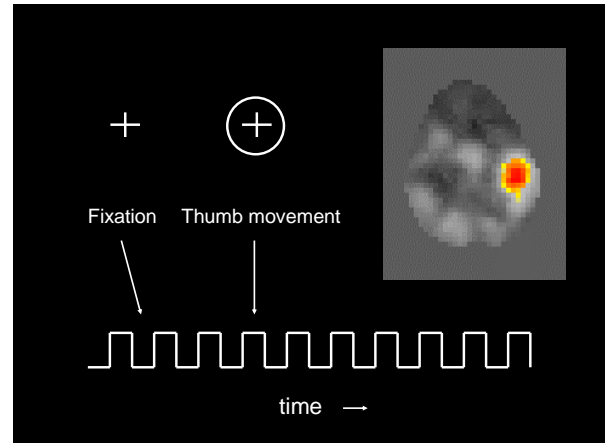


fMRI Acquisition: Temporal Effects

- Session length
- Repetition time
- Fixed vs. distributed temporal sampling
- Sparse temporal sampling
- Noise source recording
- Prospective motion correction

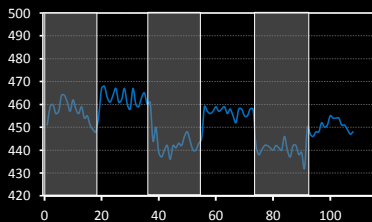
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Effect Size

mean (Move) - mean (Rest) / std dev (Rest/Move)



Rest Move Rest Move Rest Move

Methods of Calculating the Standardized Mean Difference (Effect Size)

Direction Calculation Method

$$ES = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}} = \frac{\bar{X}_1 - \bar{X}_2}{s_{pooled}}$$

Methods of Calculating the Standardized Mean Difference (Effect Size)

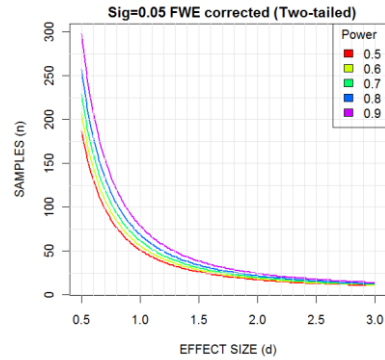
Algebraically Equivalent Formulas:

$$ES = t \sqrt{\frac{n_1 + n_2}{n_1 n_2}} \quad \text{independent t-test}$$

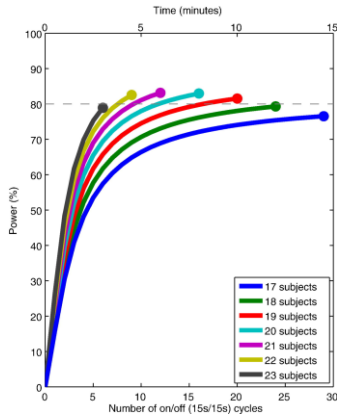
$$ES = \sqrt{\frac{F(n_1 + n_2)}{n_1 n_2}} \quad \text{two-group one-way ANOVA}$$

DB Wilson

Session Duration for Different Effect Sizes



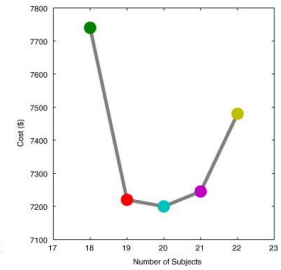
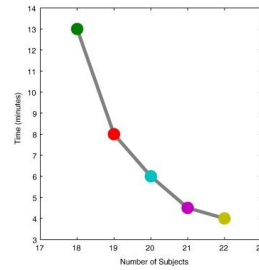
Individual Detection Sensitivity Increases with Session Length



Group Detection Sensitivity Increases with Sample Size

Mumford and Nichols, Neuroimage (2008)

Study Cost and Detection Sensitivity

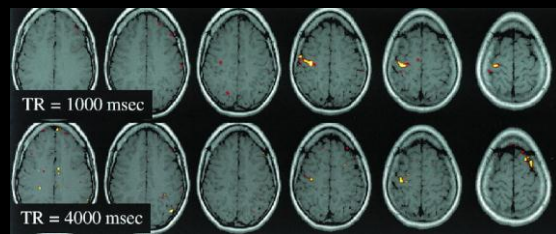


Mumford and Nichols, Neuroimage (2008)

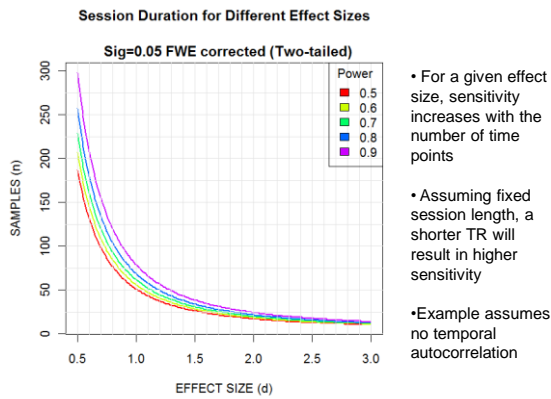
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A Short Repetition Time Increases Sensitivity

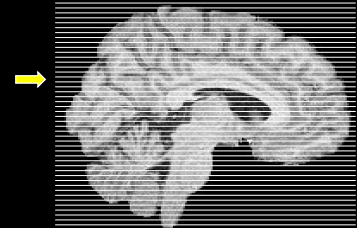


Fera et al., MRM (2003)



Optimal Repetition Time Selection

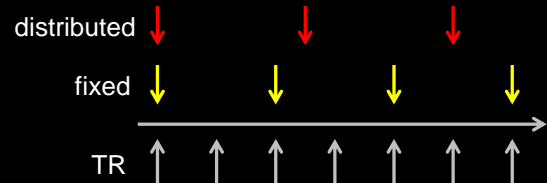
- Make the TR as short as possible given the constraints of voxel size and overall spatial coverage
- Make certain that the TR is NOT an even multiple of the task timing!



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Distributed Temporal Sampling



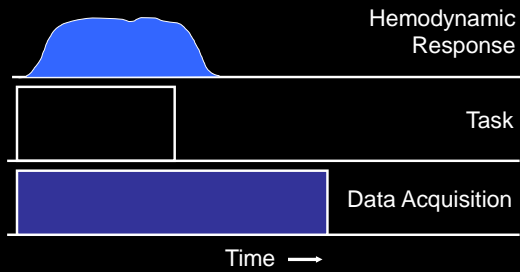
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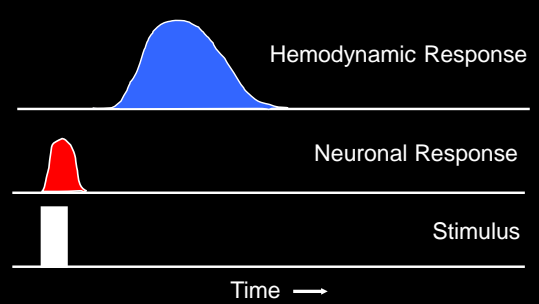
Sparse Temporal Sampling Reduces:

- Unintended auditory system stimulation
- Auditory stimulus masking
- Task interference
- Susceptibility artifacts from jaw movement

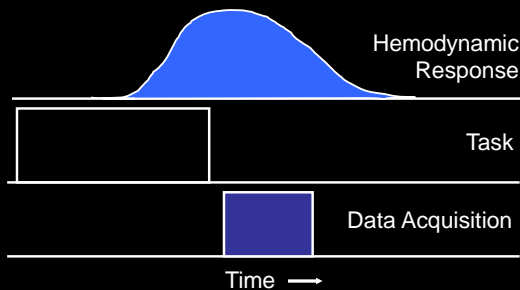
Data Acquisition Concurrent with Task



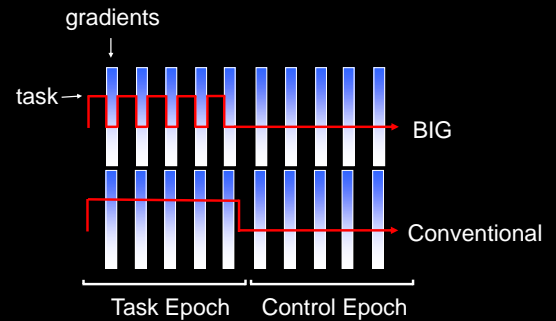
Hemodynamic Delay and Dispersion



Data Acquisition After Task Completion

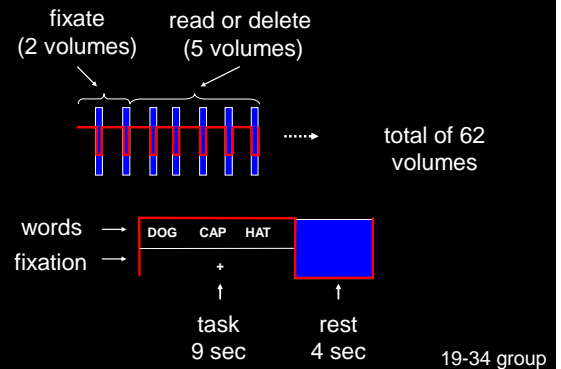


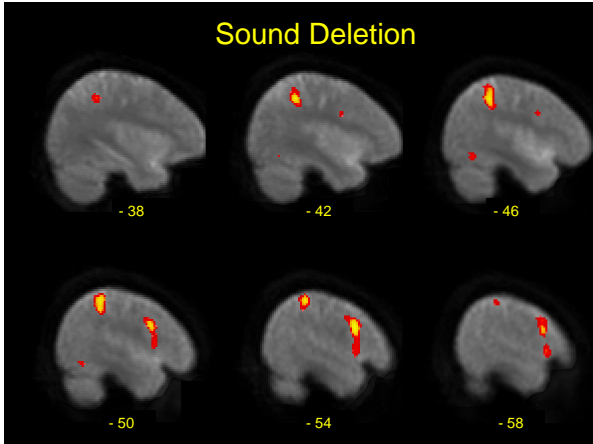
Behavior Interleaved Gradients



Task	fixate	read	delete
Stimulus	+	rat	rat
Response		rat	at
Processes	fixation	reading + vocalization	reading + phonemic manipulation + vocalization

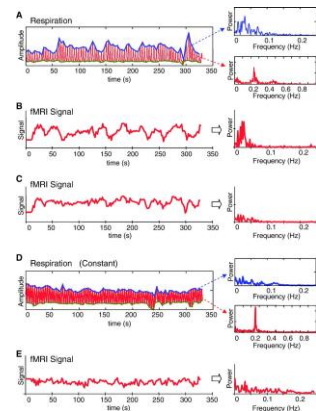
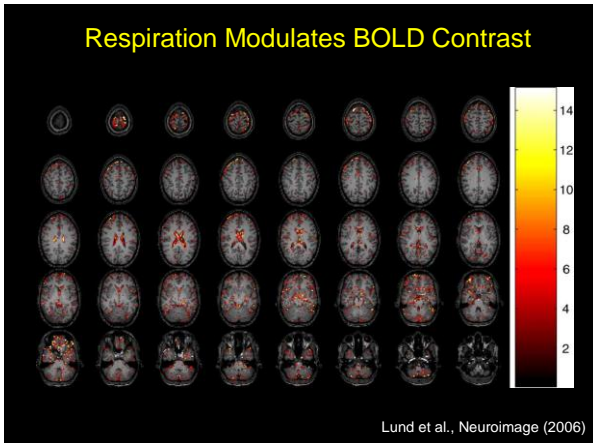
Interleaved Image Data Acquisition





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Respiration Modulates BOLD Contrast Time Series

Birn et al., Neuroimage (2006)

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Prospective Motion Correction

time

Prospective motion correction makes predictions that may be dependent on outdated information.



"We drive into the future using only our rearview mirror." - Marshall McLuhan

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