SPM8 for Basic and Clinical Investigators

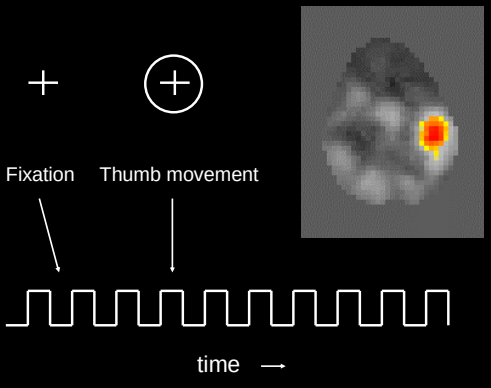
Functional MRI Data Acquisition: Temporal

fMRI Acquisition: Temporal Effects

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

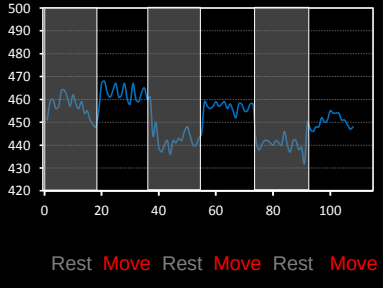
fMRI Acquisition: Temporal Effects

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



Effect Size

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



Methods of Calculating the Standardized Mean Difference (Effect Size)

Direction Calculation Method

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

DB Wilson

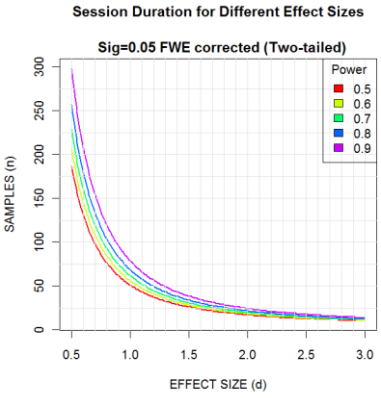
Methods of Calculating the Standardized Mean Difference (Effect Size)

Algebraically Equivalent Formulas:

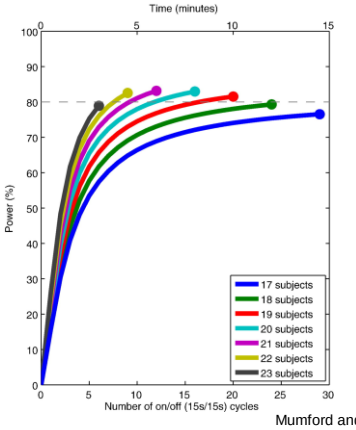
$$ES = t\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$$ independent t-test

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

DB Wilson



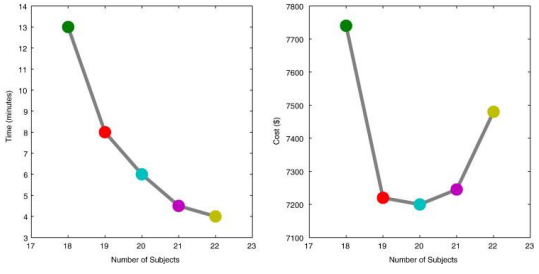
Individual Detection Sensitivity Increases with Session Length



Group Detection Sensitivity Increases with Sample Size

Mumford and Nichols, Neuroimage (2008)

Study Cost and Detection Sensitivity

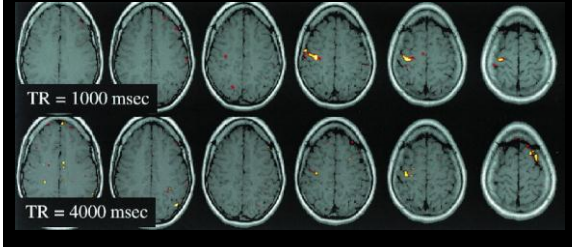


Mumford and Nichols, Neuroimage (2008)

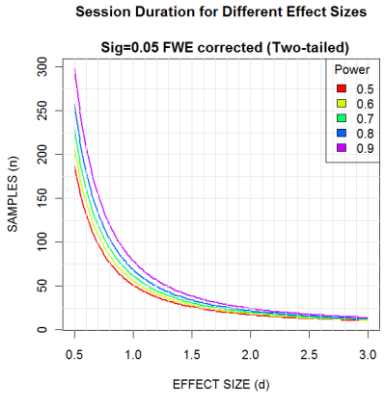
fMRI Acquisition: Temporal Effects

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

A Short Repetition Time Increases Sensitivity



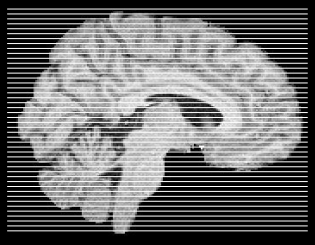
Fera et al., MRM (2003



- For a given effect size, sensitivity increases with the number of time points
- Assuming fixed session length, a shorter TR will result in higher sensitivity
- Example assumes no temporal autocorrelation

Optimal Repetition Time Selection

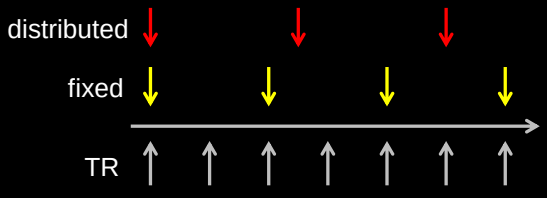
- Make the TR as short as possible given the constraints of voxel size and overall spatial coverage
- Make certain that the TR is NOT an even multiple of the task timing!



fMRI Acquisition: Temporal Effects

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

Distributed Temporal Sampling



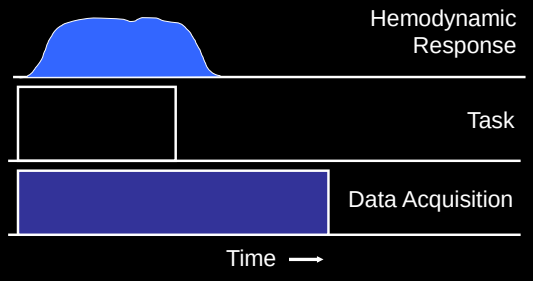
fMRI Acquisition: Temporal Effects

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

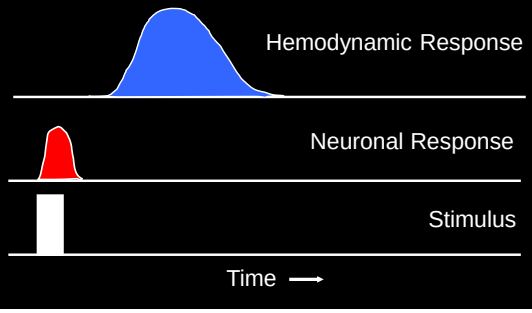
Sparse Temporal Sampling Reduces:

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

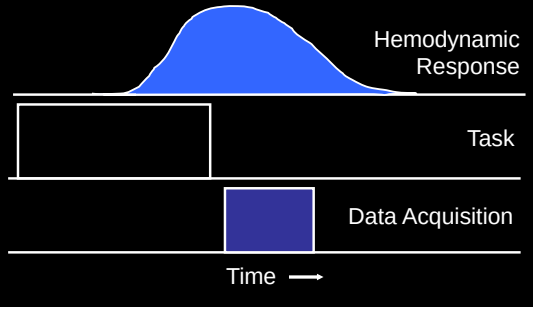
Data Acquisition Concurrent with Task



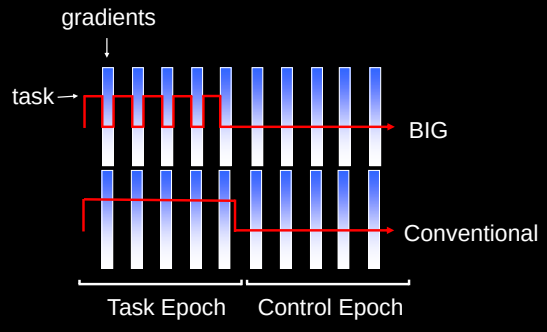
Hemodynamic Delay and Dispersion



Data Acquisition After Task Completion

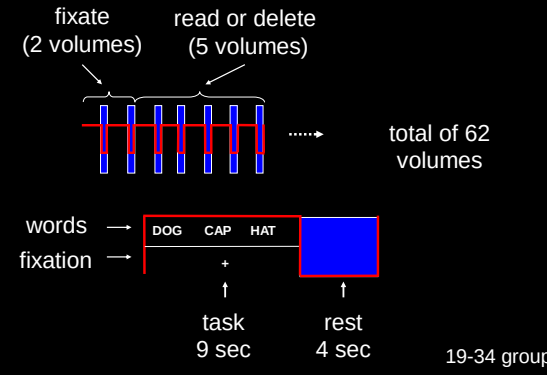


Behavior Interleaved Gradients



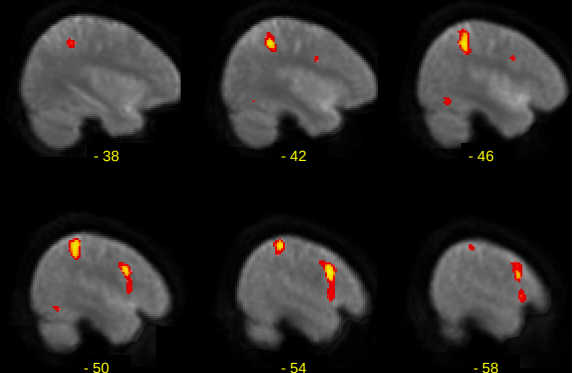
Task	fixate	read	delete
Stimulus	+	rat	rat
Response		rat	at
Processes	fixation	reading + vocalization	reading + phonemic manipulation + vocalization

Interleaved Image Data Acquisition



19-34 group

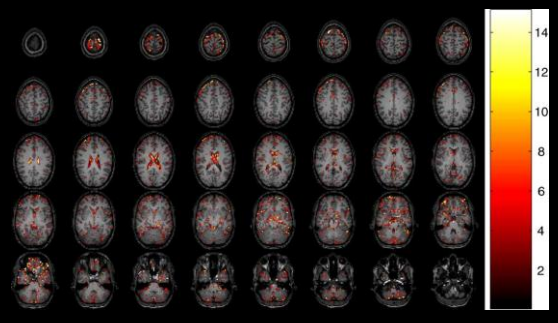
Sound Deletion



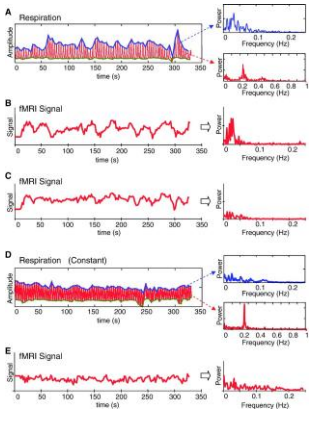
fMRI Acquisition: Temporal Effects

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

Respiration Modulates BOLD Contrast



Lund et al., Neuroimage (2006)



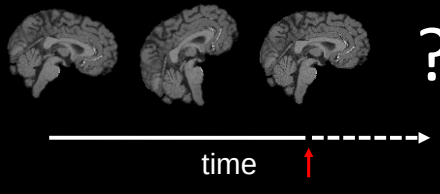
Respiration Modulates BOLD Contrast Time Series

Birn et al., Neuroimage (2006)

fMRI Acquisition: Temporal Effects

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

Prospective Motion Correction



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

fMRI Acquisition: Temporal Effects

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