

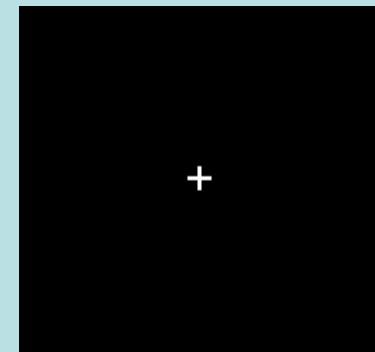
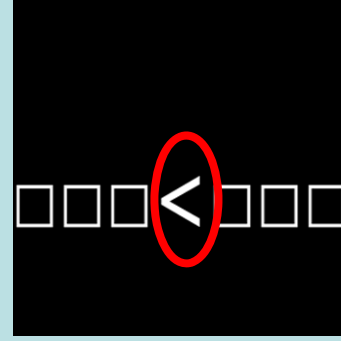
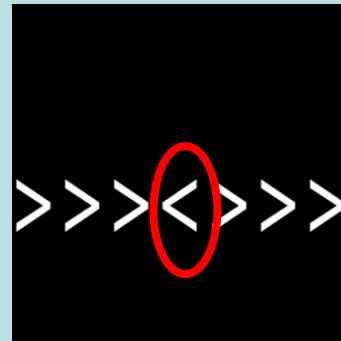
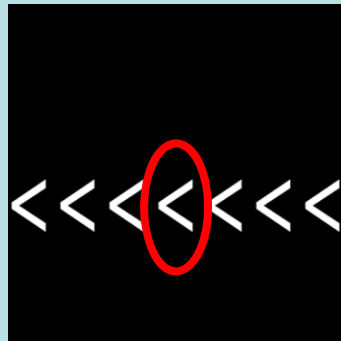
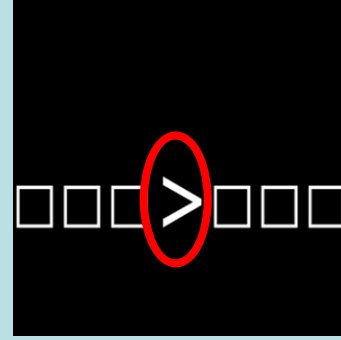
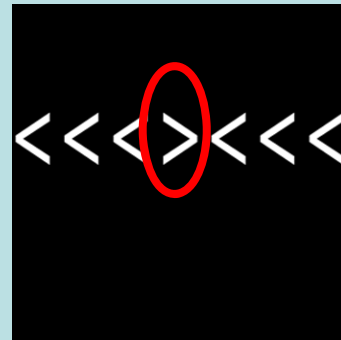
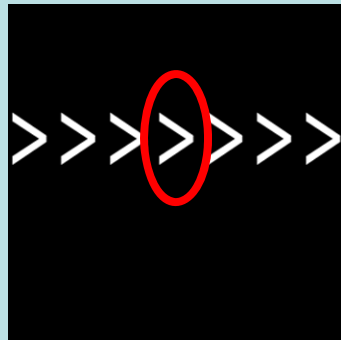
Event Related Design and Analysis with Example

David C. Zhu, Ph.D.

Cognitive Imaging Research Center
Departments of Radiology and Psychology

Zhu DC, Zacks RT, Slade JM. Brain activation during interference resolution in young and older adults: an fMRI study. *Neuroimage*. 2010 Apr 1;50(2):810-7 .

Rapid Event-Related Design



128
Congruent

128
Incongruent

128
Neutral

272
Baseline

Each stimulus was presented 2.5 sec.

Four 7-min runs

Rapid Event Related Design

- Time-efficient
- Less predictable



Keeps the subject's general attentiveness level relatively constant.



Incongruent – Congruent



Conflict resolution



Executive function

Data Acquisition

3T GE Signa EXCITE scanner

8-channel head coil

Echo planar images:

34 contiguous 3-mm axial slices,

TE = 27.7 ms,

TR = 2500 ms,

flip angle = 80°,

FOV = 22 cm,

matrix size = 64 × 64,

ramp sampling.

Data Pre-processing and Analyses

AFNI: Deconvolution analysis and ANOVA

Live demo if possible

Response time and accuracy comparison between the younger and older populations

	Congruent Condition		Incongruent Condition		Response Time Comparison
	Number of Correct Response	Mean Correct Response Time (ms)	Number of Correct Response	Mean Correct Response Time (ms)	Incongruent – Congruent (ms)
Young Group	125 ± 8	675 ± 119	124±9	805±188	(~19%) 130±92
Old Group	120±12	787±97	115±18	994±206	(~26%) 207±146

22 younger adults (11 males, age 20 ± 3)

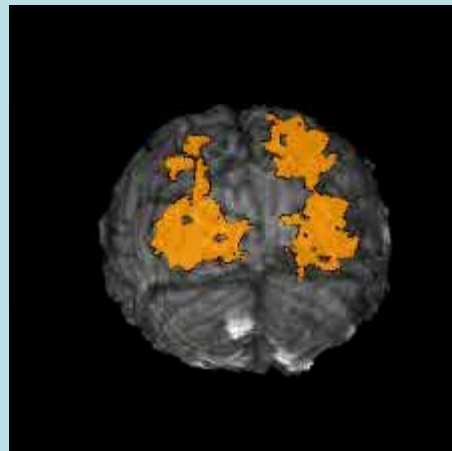
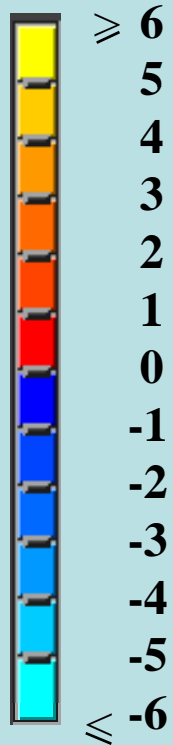
22 older adults (9 males, age 74 ± 6)

Brain Activation Comparison:

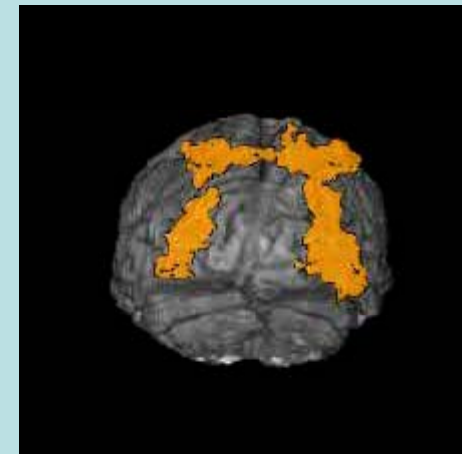
“Incongruent – Congruent” Contrast

(voxel based $p \leq 0.005$, whole brain corrected $p \leq 0.021$)

t
value



Younger adults



Older adults

Common for both age groups:

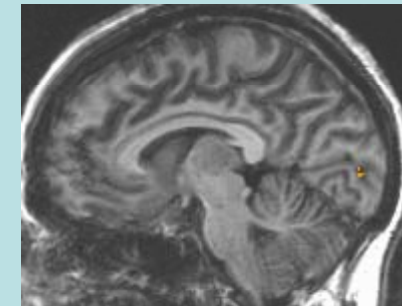
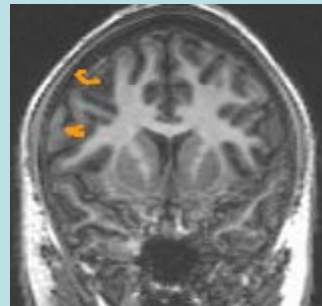
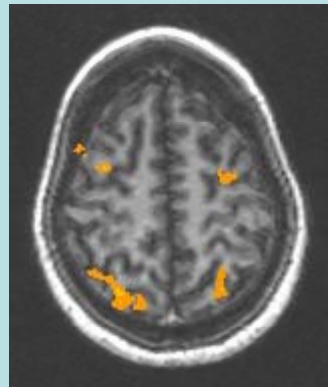
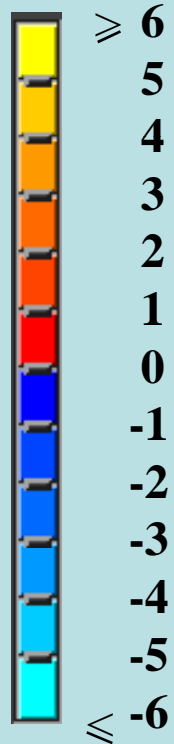
- Frontal: Right inferior frontal gyrus (IFG) and both right and left middle frontal gyrus (MFG).
- Visual Processing: Middle occipital gyrus, inferior occipital gyrus, precuneus, superior parietal lobule and surrounding regions.

Brain Activation Comparison:

“Incongruent – Congruent” Contrast

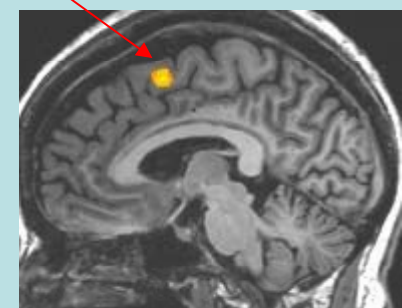
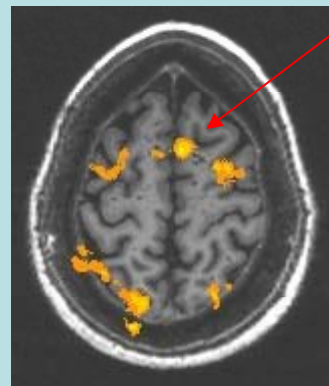
(voxel based $p \leq 0.005$, whole brain corrected $p \leq 0.021$)

t
value



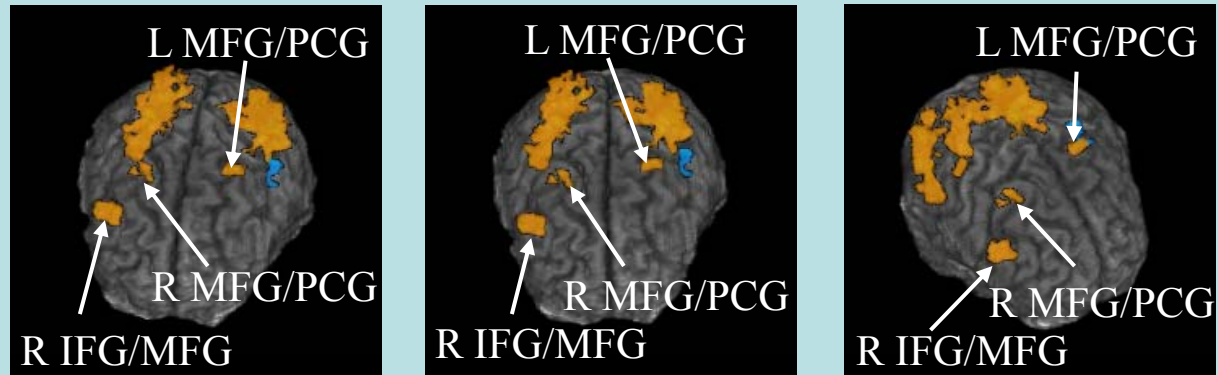
Younger adults

Left Superior Frontal Gyrus

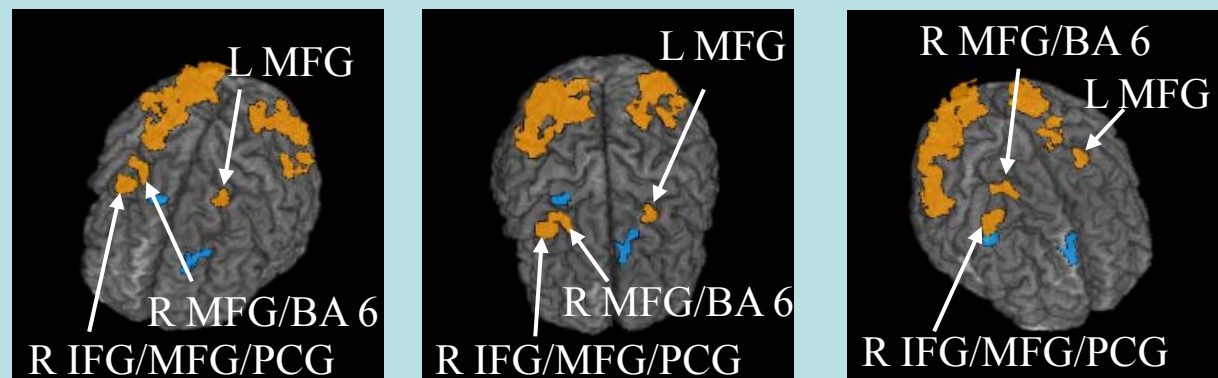


Older adults

The right IFG/MFG cluster was smaller in the older group and the centroid location was shifted by 19.7 mm.

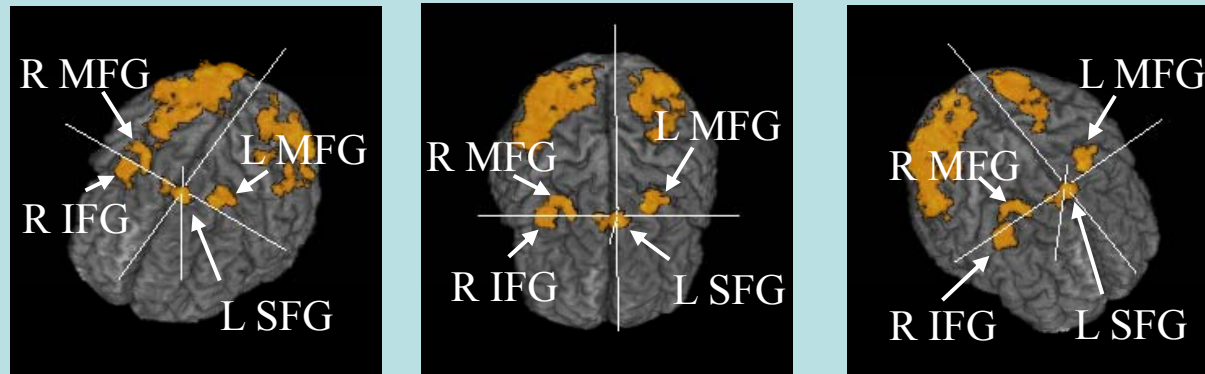


(a) Young adults (successful trials, "IC-C")



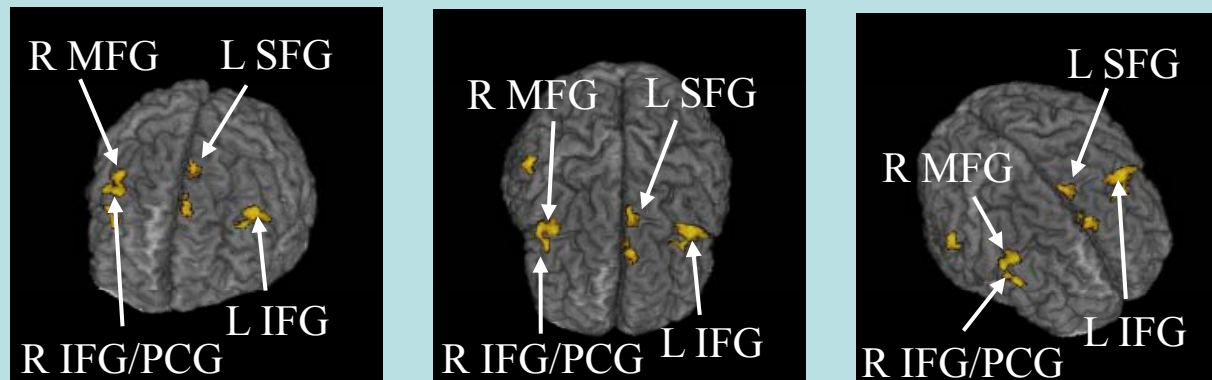
(b) Older adults (successful trials, "IC-C")

A 153 mm³ cluster at the left SFG/MeFG (medial frontal gyrus) (centroid coordinate (L6, A9, S51)) was found before whole-brain correction for the older group, but was not found for the younger group

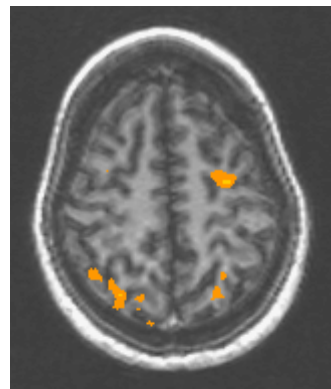


(c) Older adults (successful and error trials together, “IC-C”)

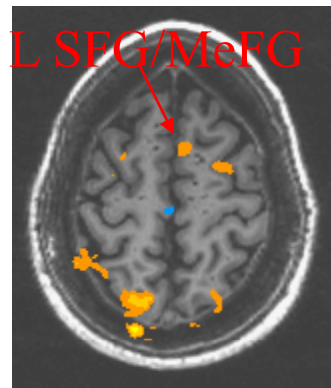
However, partially driven by errors:



(d) Sub-group of nine older adults (“error IC vs. successful C”)

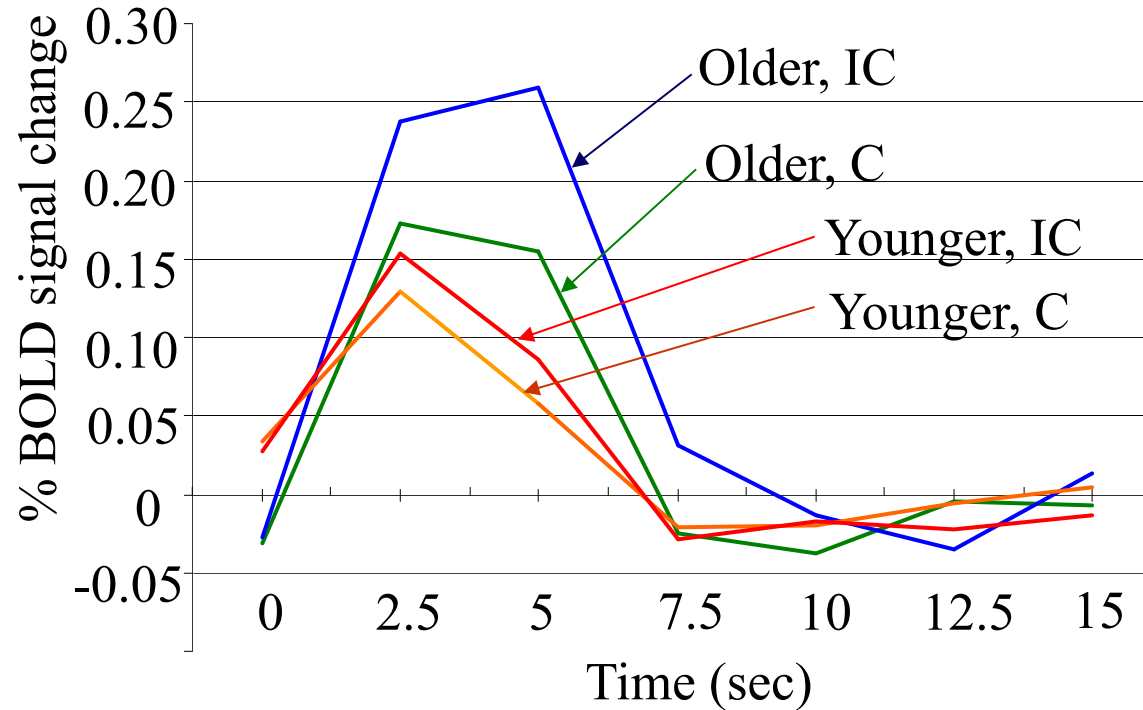


Younger Adults



Older Adults

(a)



(b)

The within-group whole-brain differential activation during successful flanker trials (“Incongruent – Congruent”) (voxel-based p value ≤ 0.005 but whole-brain uncorrected) revealed a cluster that is more active for the Incongruent condition at the left SFG/MeFG region with older adults but this cluster was not found at the younger adults (a). The mean impulse response functions for older and younger group in conditions IC (Incongruent) and C (Congruent) are plotted at this cluster (b).

Design: give_me_stimuli.s

TS1_analy.1D, TS2_analy.1D,
TS3_analy.1D, TS4_analy.1D

TSall_analy.1D,
concat.1D

E-Prime Programming

Collect Data

analyze_ts_fwhm4.s

register.s: register many image files to AFNI format.

3dTshift: slice timing adjustment

3dvolreg: motion correction

3dTcat: concatenate all fMRI data together

3dmerge: spatial blurring

mask generation: identify brain region with 3dcalc or 3dAutomask

Link design matrix (TSall_analy.1D, concat.1D)

3dDeconvolve (deconv.s): Compare fMRI image data with design matrix

decon_TS (the "bucket")

PerSigCh.s: calculate % signal change

FLY_group_ANOVA2_analyze.s: group analysis from all subjects

MonteCarlo_moreIterfwhm4.s
(AlphaSim)

gen_clusterP5103.s (3dclust and 3dmerge): cluster analysis

Final results