Neuroimaging of Cognition

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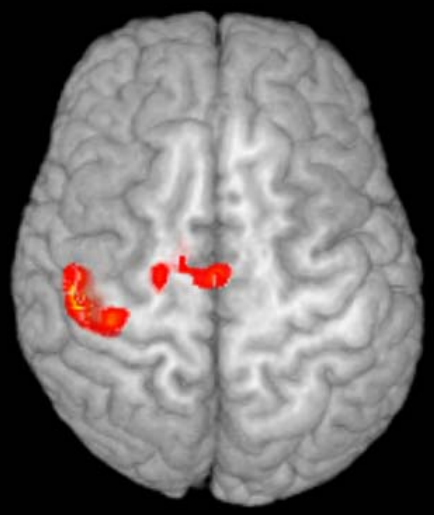

Neuroimaging of Cognition

- Covert Detection of Cognitive Activity
- Credibility Assessment
- Augmented Cognition

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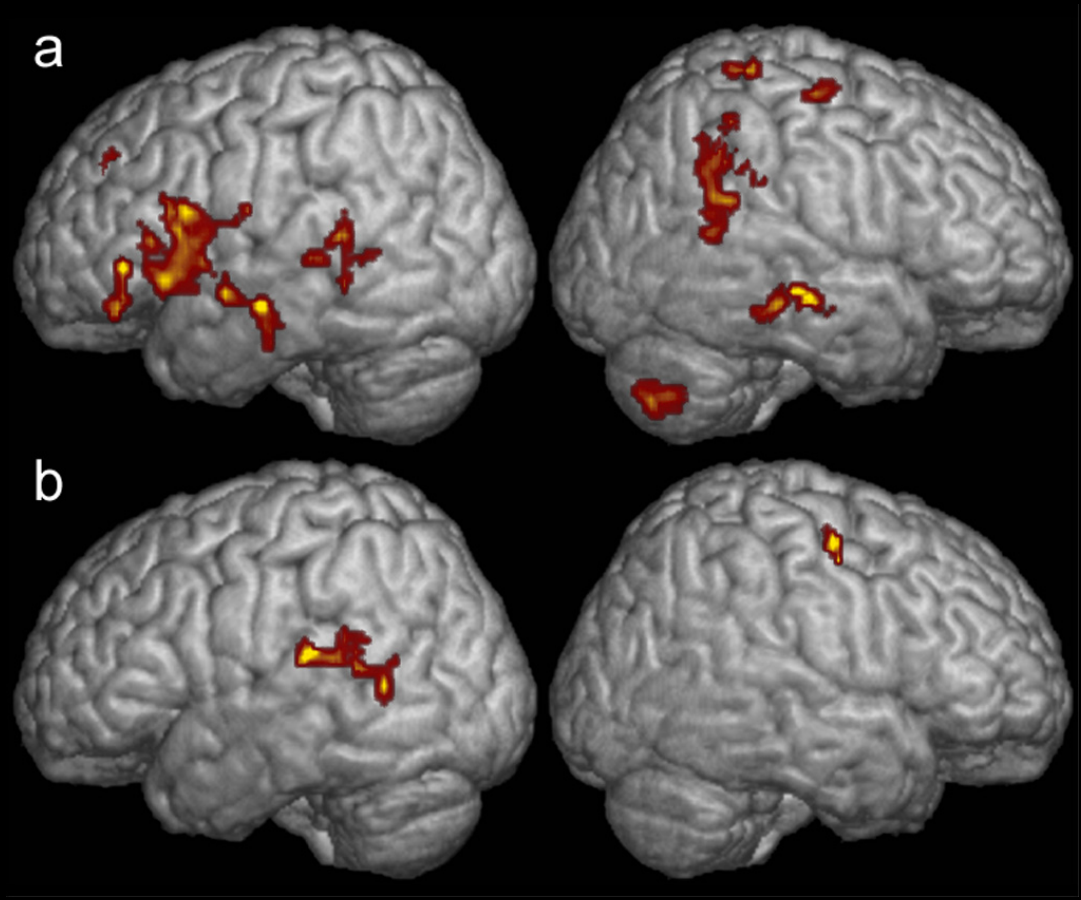
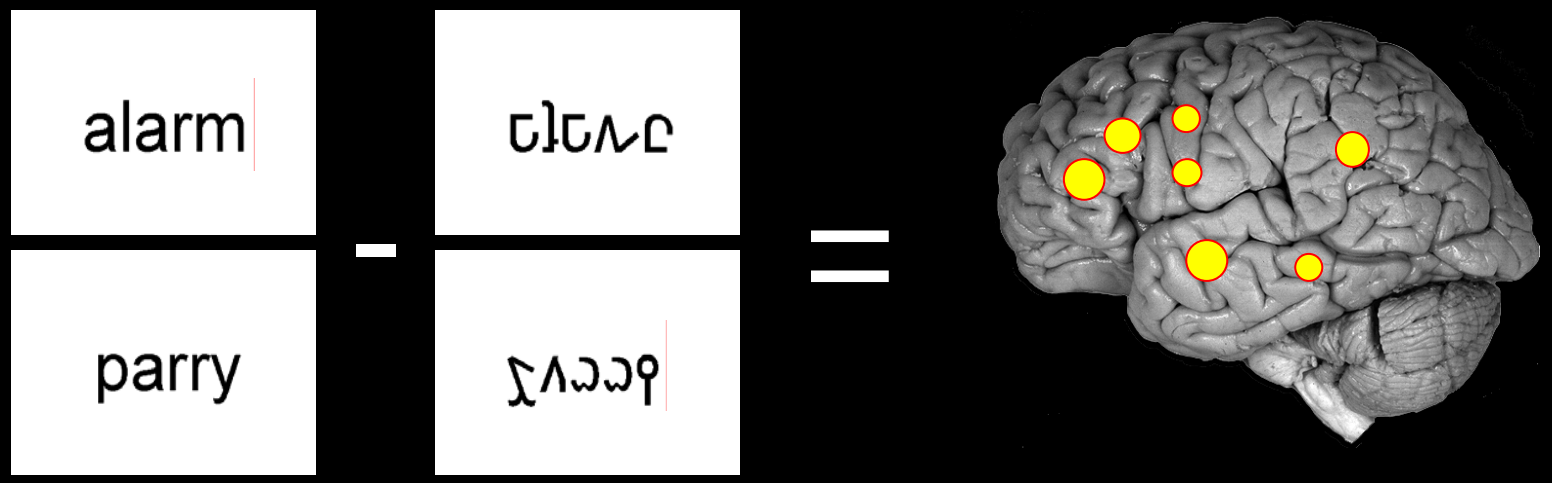
Development of Neural Mechanisms for Reading



Turkeltaub et al., Nature Neuroscience (2003)

Didn’t I tell you not to read it?

Implicit Word Processing

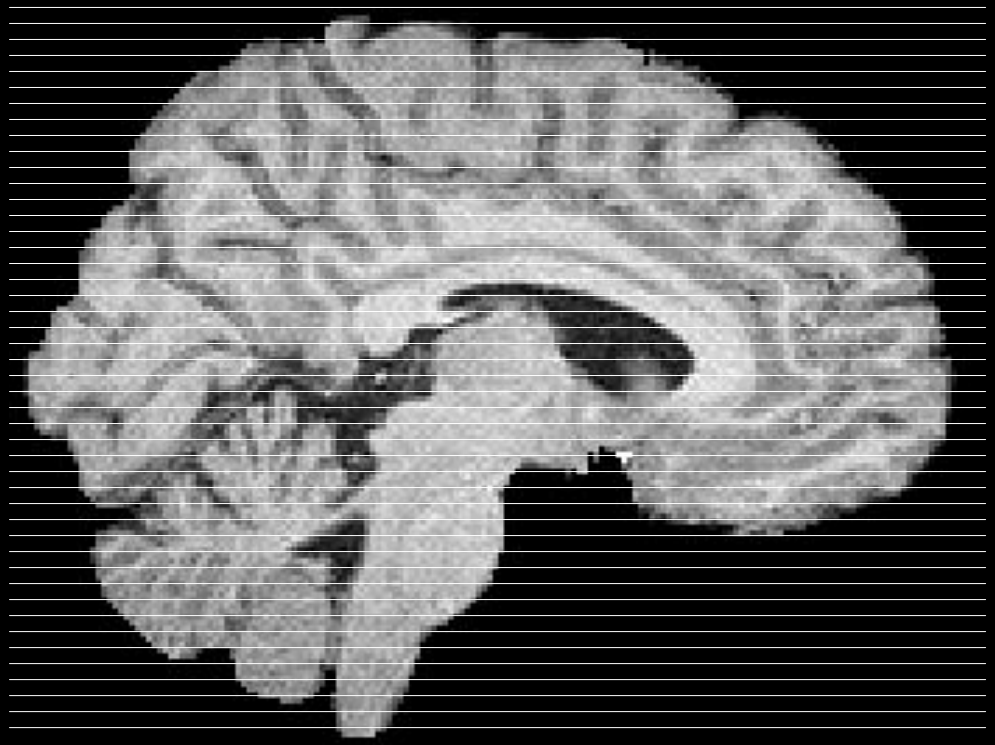


Adapted from Price et al, 1996

MAGNETOM
Trio

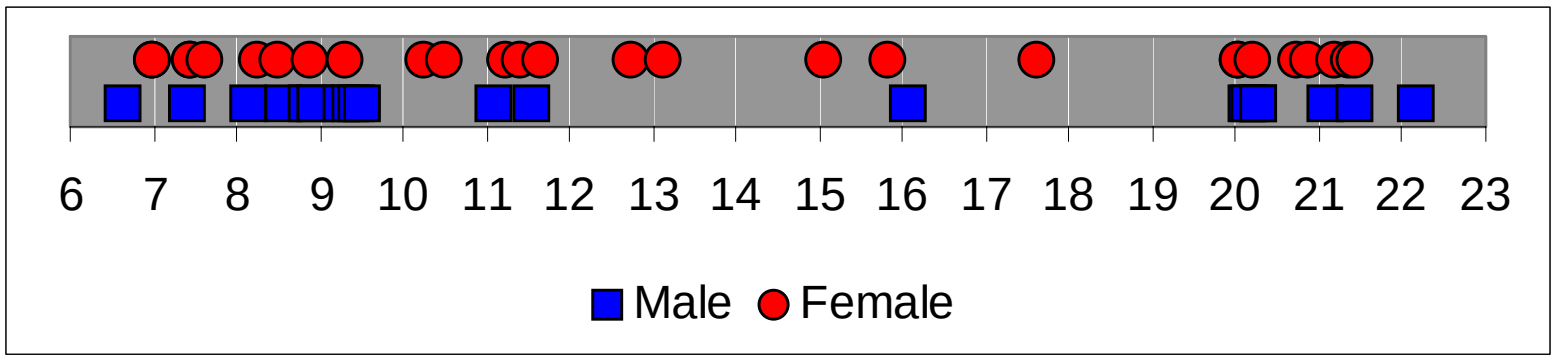
Data Acquisition

- BOLD contrast using echo planar imaging
- 7 minute run
- 104 whole head volumes
- 46 axial slices per volume
- 3.6 mm^3 voxels

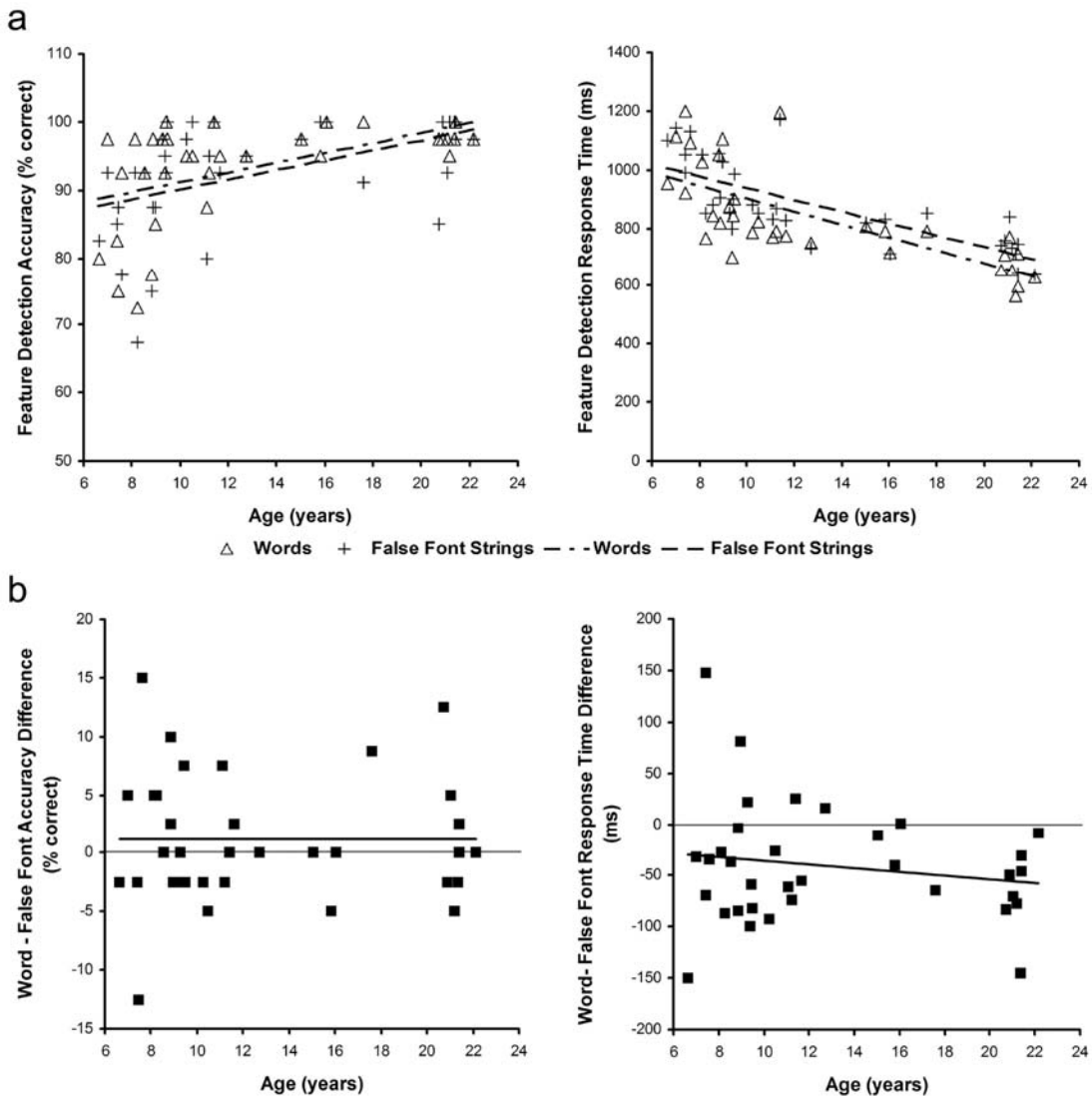


Subjects

- 47 subjects (20 male, 27 female)
  - age 6.7 → 22.2 (mean= 13.6)
  - right handed
  - no learning disabilities
  - no neurological disorders



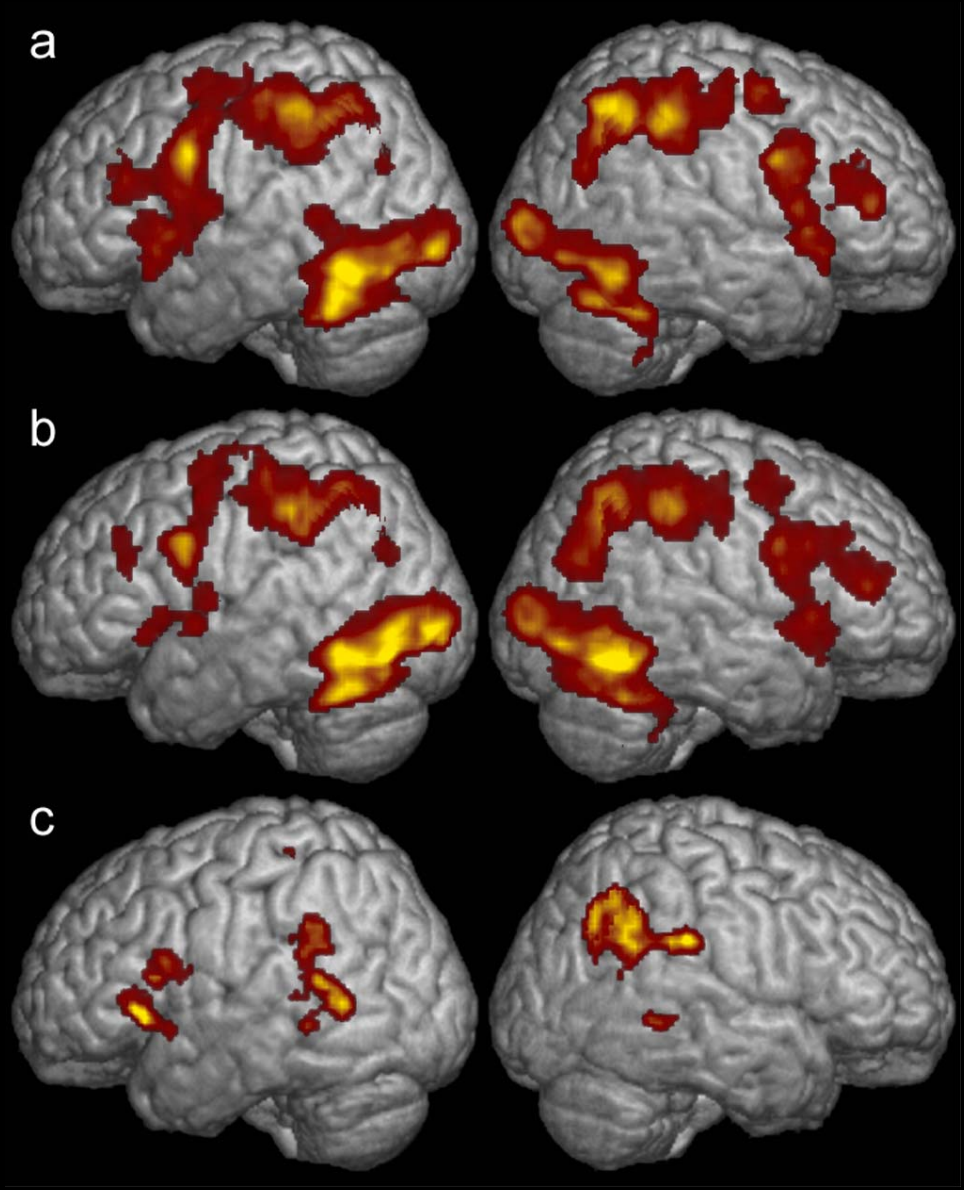
Feature Detection Performance



words

false fonts

words – false fonts



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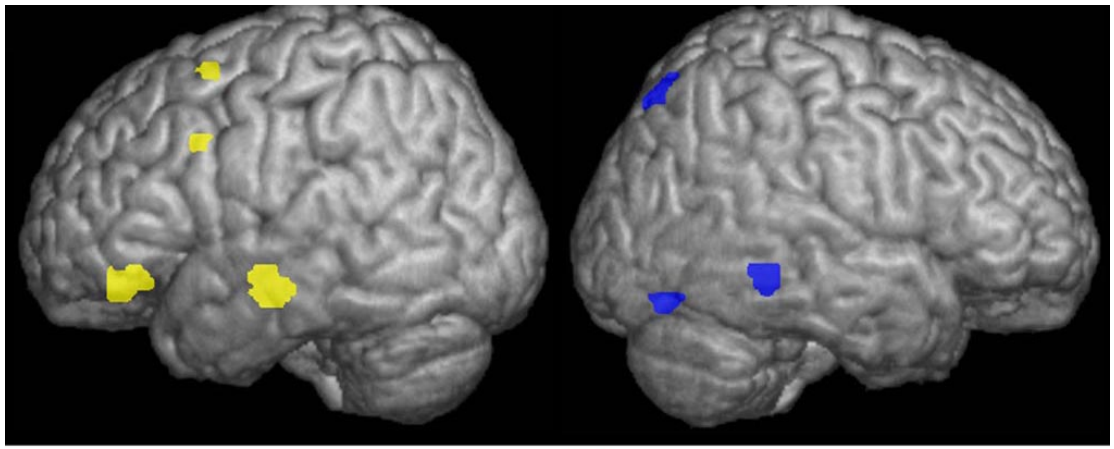
Correlation Between Implicit Reading Activity and Reading Scores

(Letter-Word I.D. + Word Attack + GORT)



	Brodmann Area	Volume (mm^3)	Cluster R	Peak Z	x	y	z
Positive							
Left							
Middle Temporal Gyrus	21	1,168	0.72	5.47	-51	-12	-11
Inferior Frontal Gyrus	47	1,008	0.66	4.31	-51	38	-17
				4.16	-46	32	-12
Superior Frontal Gyrus	6	240	0.60	4.13	-20	10	51
Cingulate Gyrus	31	456	0.58	3.98	-2	-45	28
Inferior Frontal Sulcus	44/9	264	0.60	3.85	-34	13	27
Negative							
Right							
Inferior Temporal Sulcus	21/37	416	-0.64	-4.69	65	-39	-10
Precuneus	7	376	-0.59	-4.02	8	-73	48
Fusiform Gyrus	19	264	-0.59	-4.00	48	-74	-13

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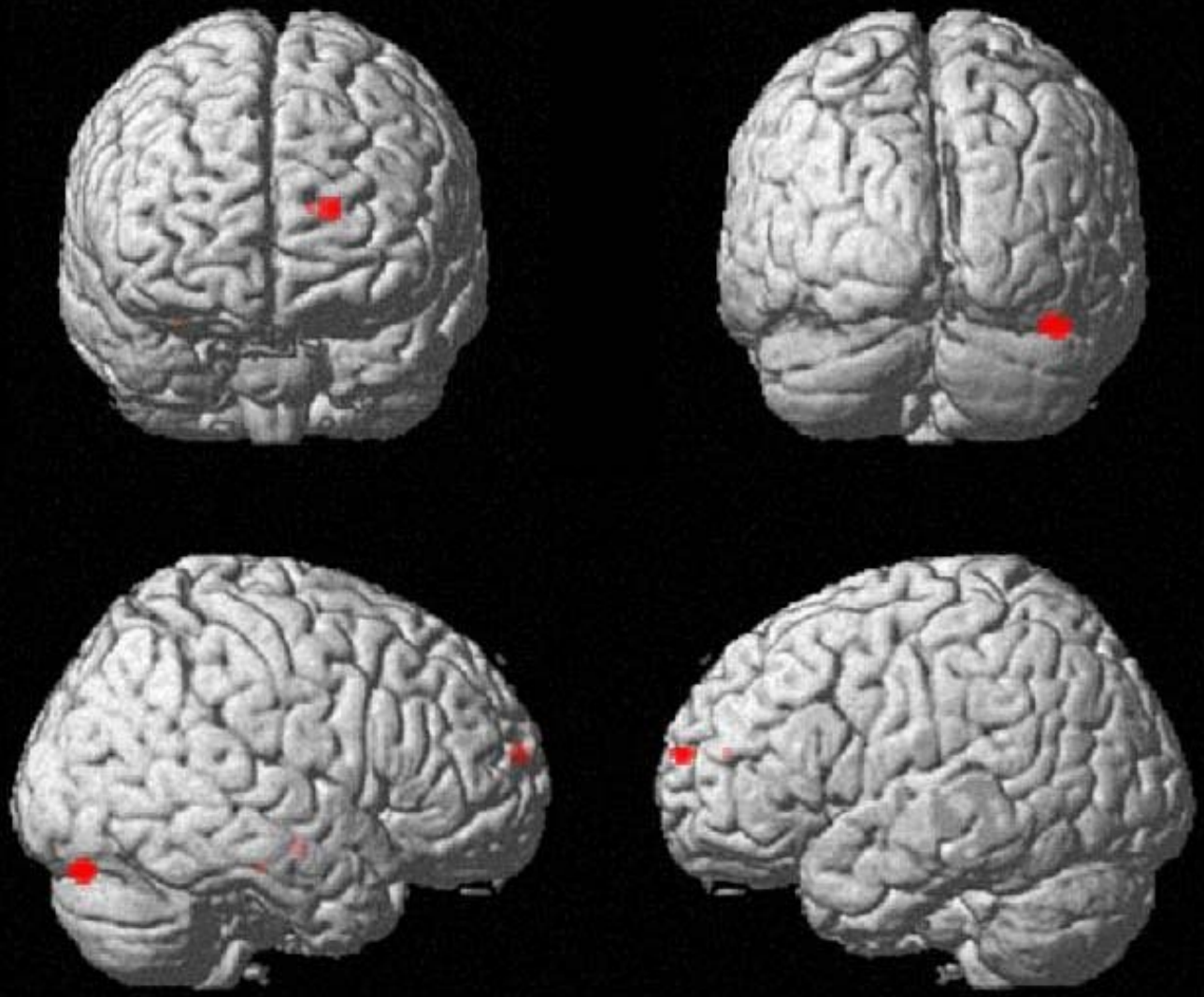
Credibility Assessment

- Variant of polygraph examination
  - Event-related fMRI design
  - Physiological monitoring
- Concealed Information Test
- Contrast of deceptive and truthful conditions



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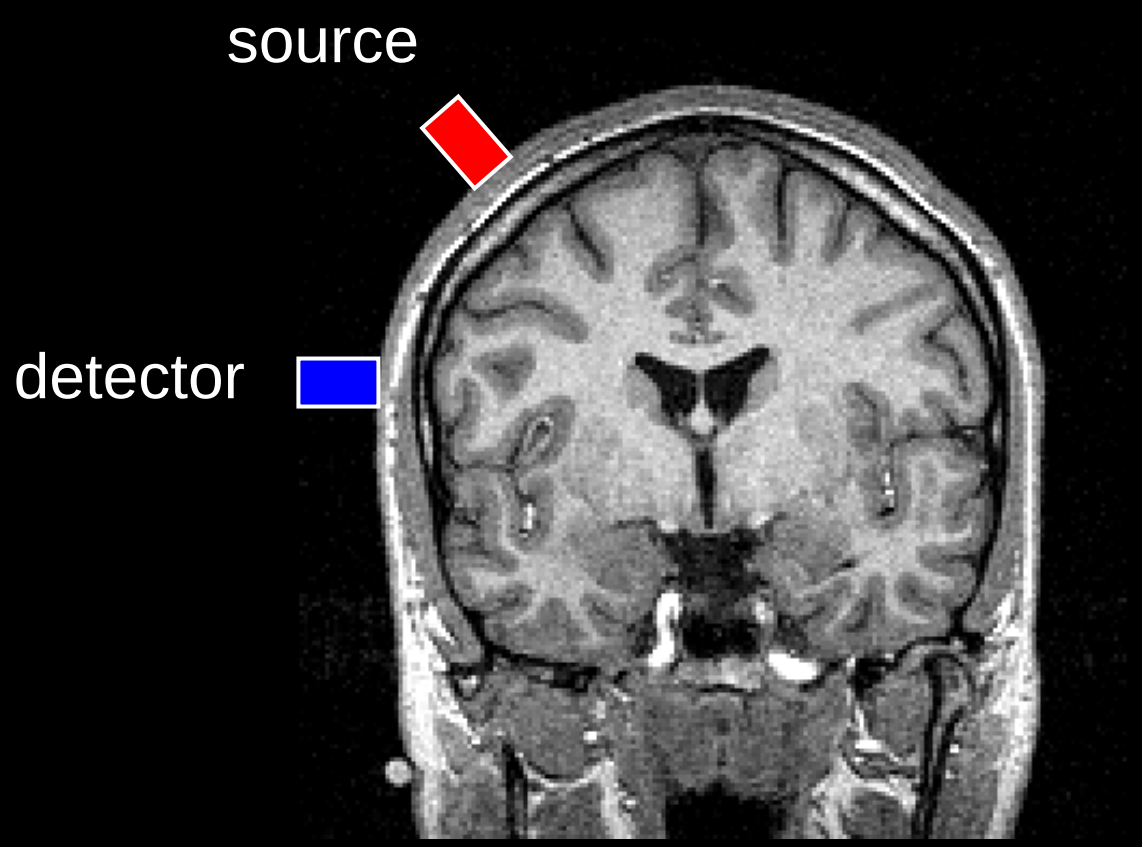
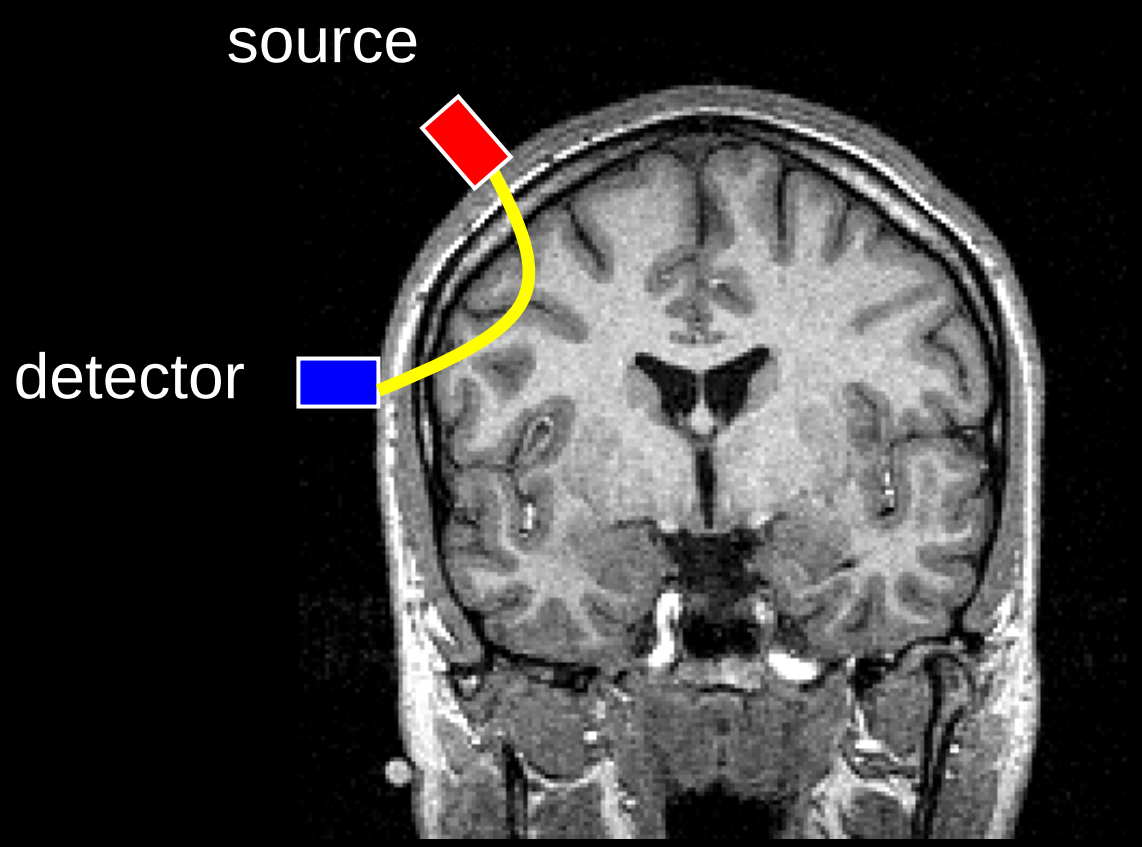
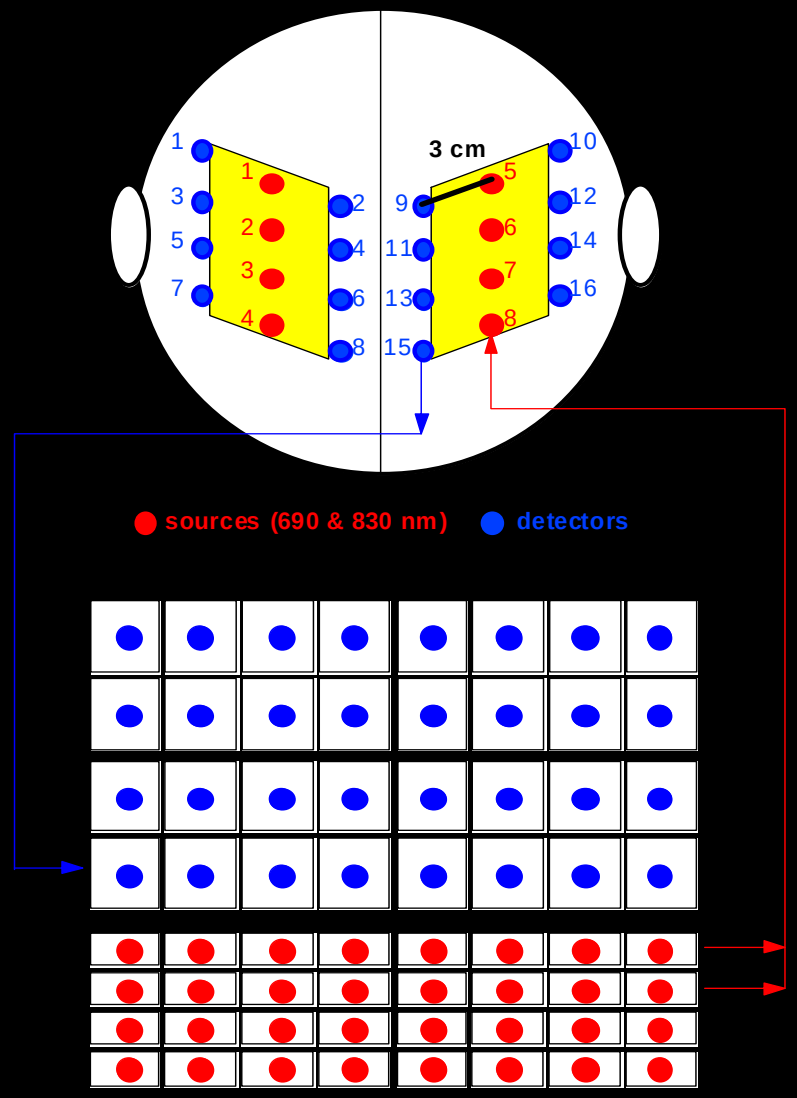
Near Infra-red Spectroscopy



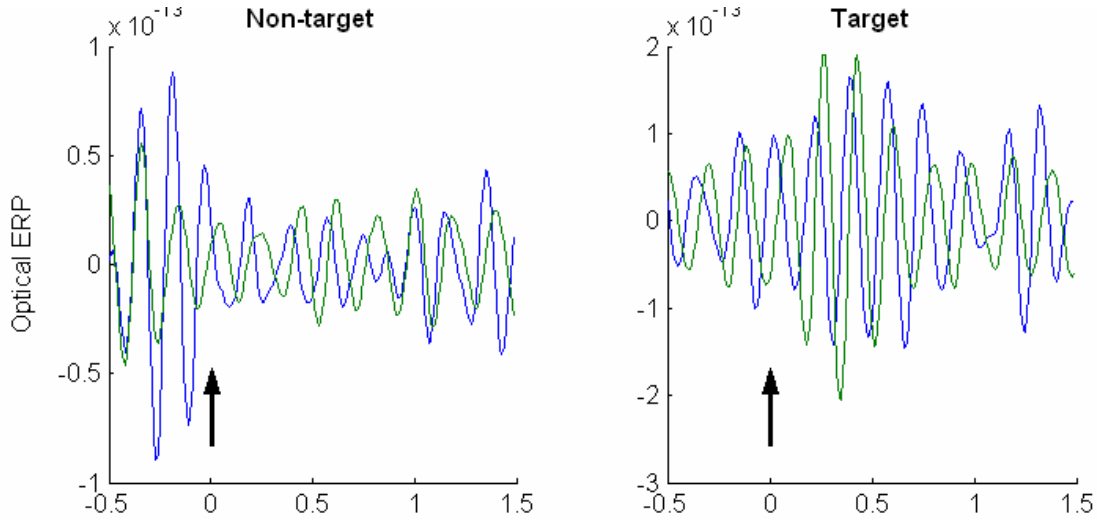
Near Infra-red Spectroscopy

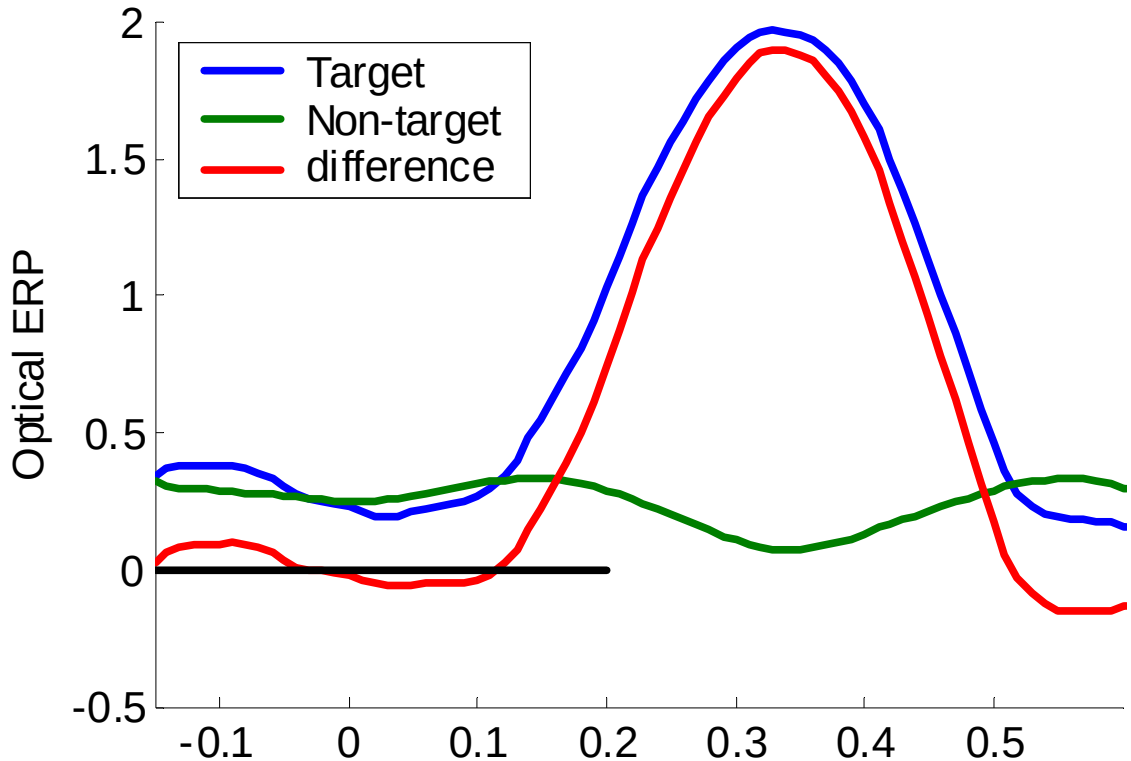
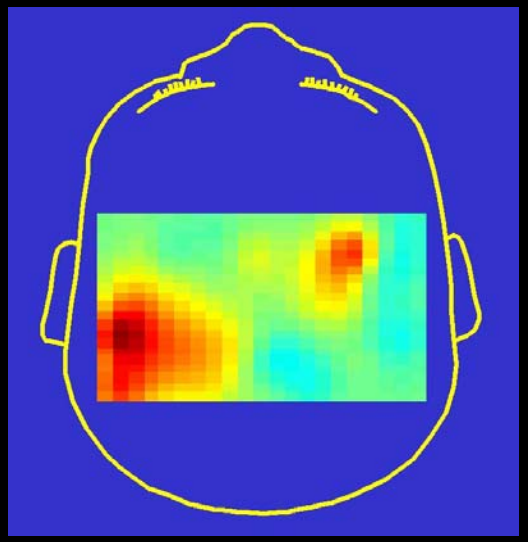
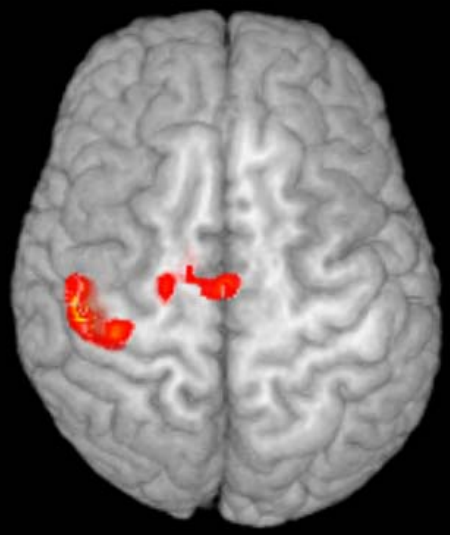


Near Infra-red Spectroscopy System



“Animal/no-animal” detection task


Non-target
Target
x 10^-13
Optical ERP
1
0.5
0
-0.5
-1
2
-2
-3
-0.5
0
0.5
1
1.5


Target
Non-target
difference
Optical ERP
2
1.5
1
0.5
0
-0.5
-0.1
0
0.1
0.2
0.3
0.4
0.5

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