



fMRI reveals the role of the left fusiform gyrus in letter detection

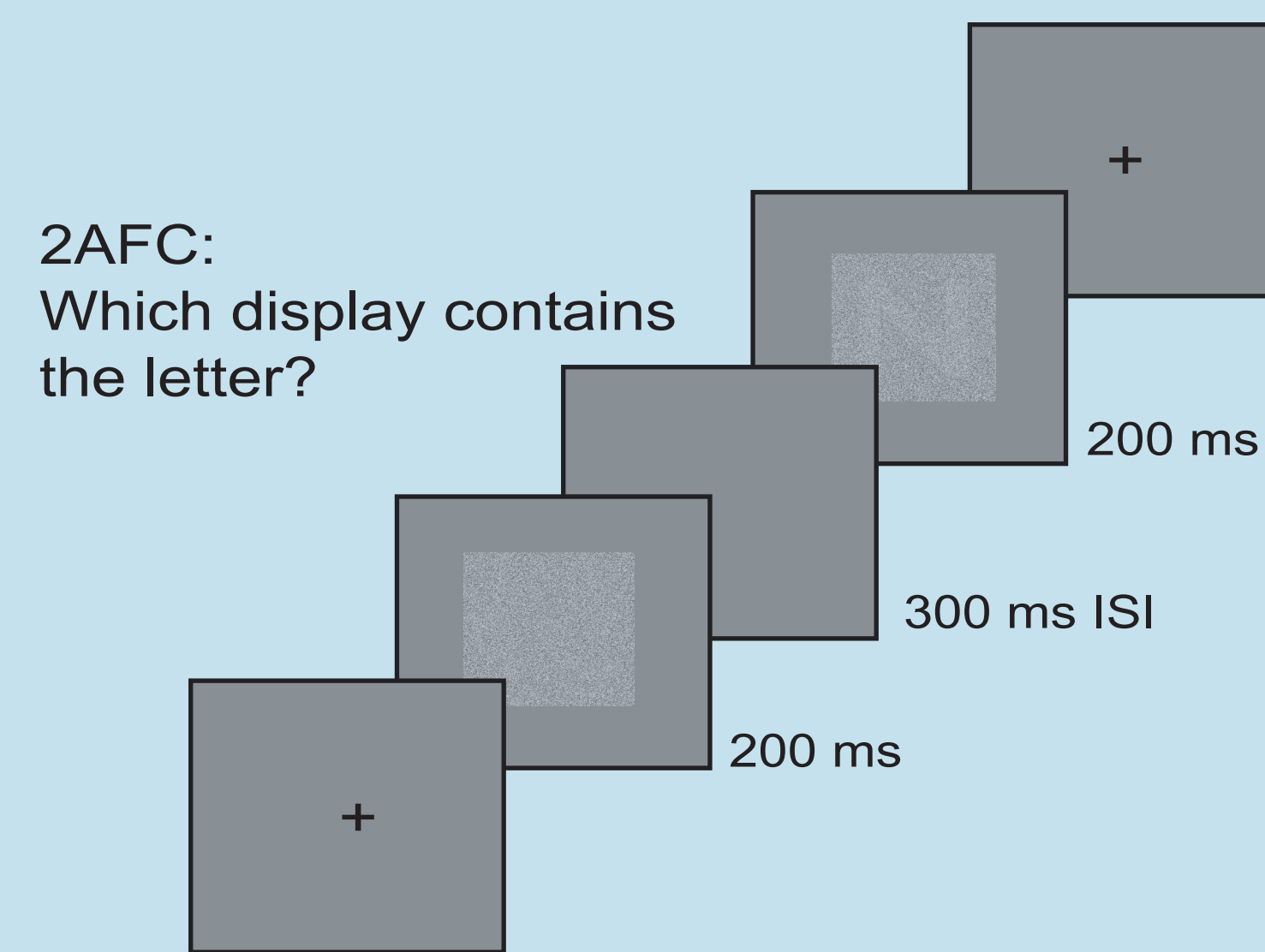
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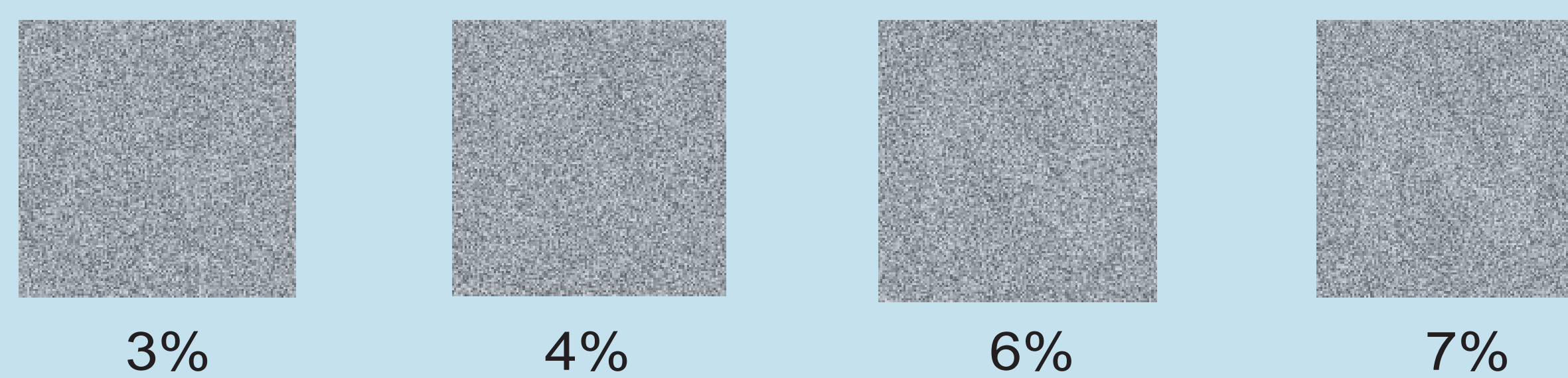


METHODS

Psychophysics: For each observer we measured threshold contrast (in the magnet) and did all subsequent fMRI testing at four contrasts chosen to span that observer's threshold, e.g. 3%, 4%, 6%, 7%. The signal was always the letter **N** presented in the Sloan font.

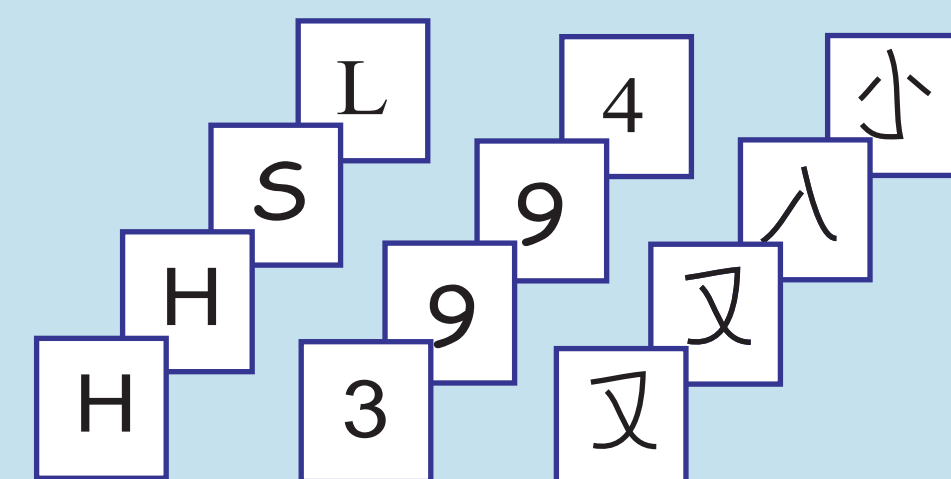


For each observer, the letter was displayed at four contrasts, two below threshold and two above:



Region-of-interest localizer: To localize a letter-selective area in the visual system, we measured the BOLD response to a blocked one-back task using Roman letters, numerals and Chinese characters.

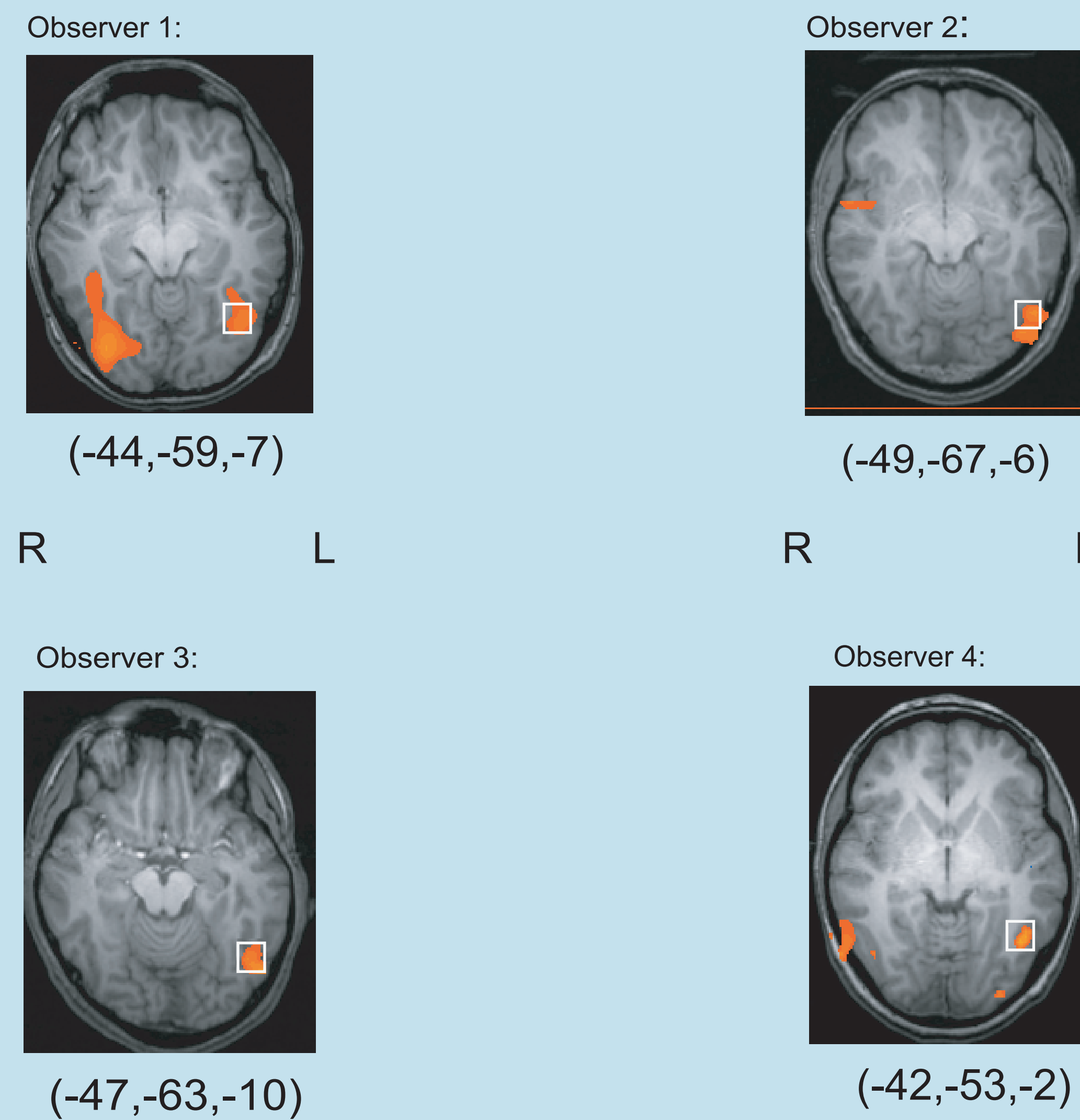
Localizer stimuli:



Activation by letters in noise: Experimental runs: Single event design, where letters in noise are presented as a 2AFC for 250 ms each with a 500 ms interstimulus interval. A red cross preceded the first stimulus display for 2000 ms and a tone sounded for 1000 ms prior to stimulus onset. Observers responded as to which of the two displays contained the signal. A fixation cross appeared after stimulus offset for 6 seconds. Total trial length was 9 seconds with 1 second of stimuli. Resulting BOLD activation was averaged over 6 seconds starting 3 seconds after stimulus onset.

RESULTS

Statistical parametric maps of localizer task



We found an area in the left fusiform gyrus in 4 of 5 observers that responded more to Roman letters than to Chinese characters and more to letters than to numerals. This replicates previous results showing selectivity to isolated letters (James et al, 2004) and letter strings (Polk et al, 2002) in this region. We used this as our ROI.

Imaging parameters:

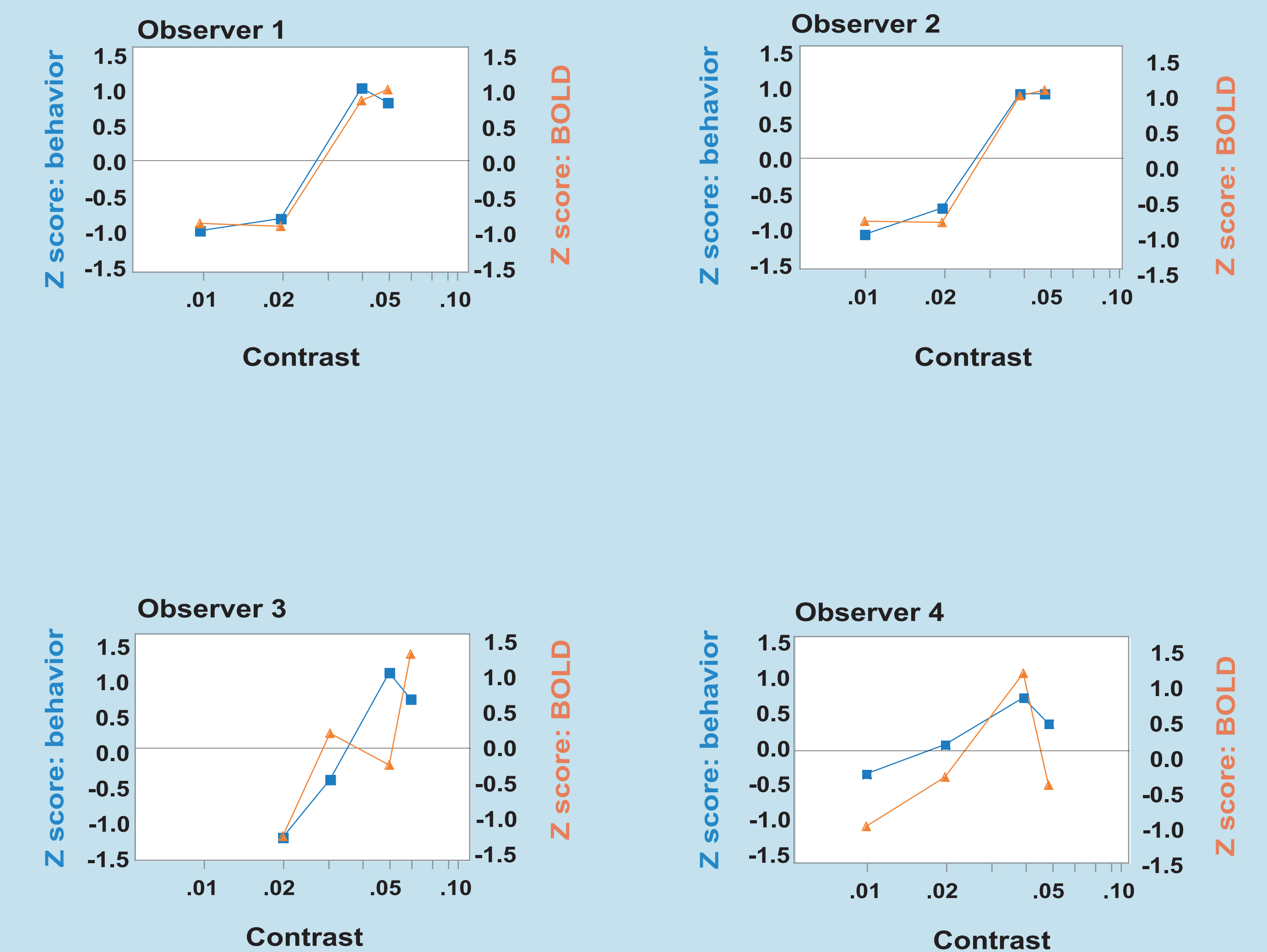
- 3 Tesla, whole body GE with birdcage head coil. FOV: 24 X 24 X 12.6 cm RES: 64 X 64 pixels with 18 axial scan planes per volume. Voxel size: 3.75 X 3.75 X 7.00 mm.
- Functional images collected using gradient echo T2* EPI acquisition (TE=25 ms, TR=2000 ms, flip angle=70°). Structural images collected using T1 weighted 3D FSPGR acquisition.
- Data analysed using Brain VoyagerTM 3-D tools.
- 3-D motion correction, gaussian filtering: spatial: FWHM 6 mm; temporal: FWHM 4 s

References:

James, James, Jobard, Wong & Gauthier, (2004). Letter processing in the visual system: different activation patterns for single letters and strings. Submitted to Cog Aff Beh Neuro. Polk, et al. (2002). Neural specialization for letter recognition. JOCN, 14;2, 145-159. P30EY08126

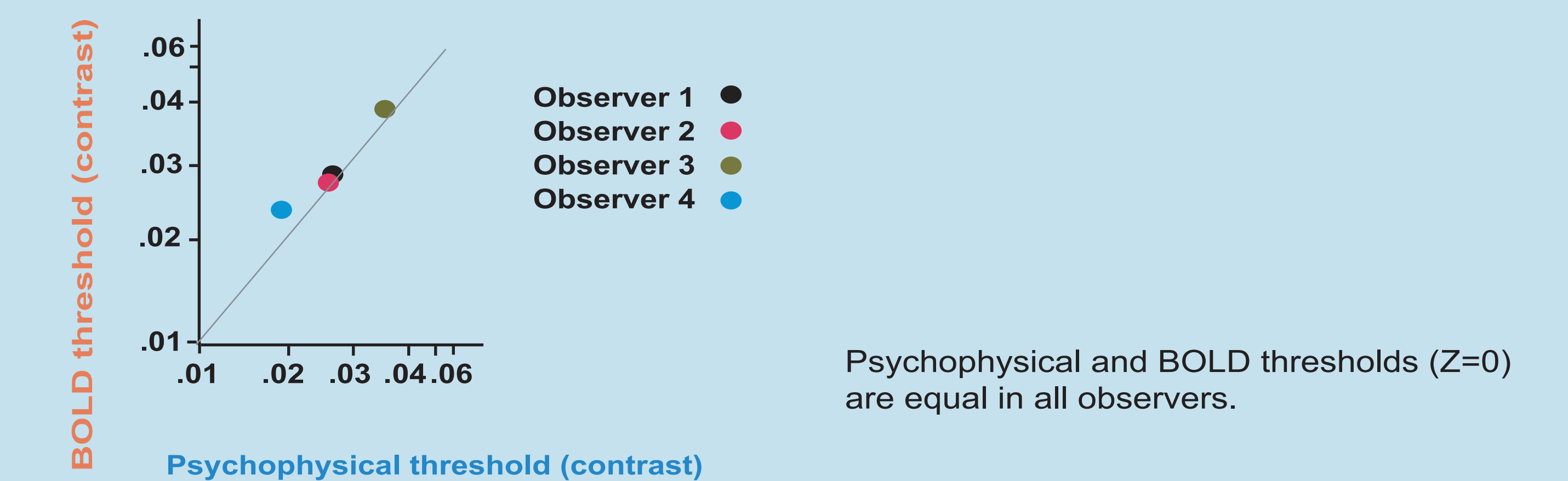
RESULTS

Psychophysical performance vs. BOLD signal



Measure detection performance while scanning: convert to Z score. BOLD activation: Measure signal in letter ROI during detection task: convert to Z score

Average accuracy, across observers, at the four tested contrasts is 36%, 42%, 86% and 84%



Psychophysical and BOLD thresholds (Z=0) are equal in all observers.

CONCLUSION

We have localized an area in the left fusiform gyrus that responds more to Roman letters than to numerals and Chinese characters. We measured threshold luminance contrast for letter detection both psychophysically and physiologically. Psychophysical and BOLD thresholds are equal. We conclude that the 'letter' area in fusiform gyrus is involved in letter detection.