



Neural-Correlates of Perceptual Grouping During a Visual Illusion.

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Introduction

Grouping local elements of our visual environment together is crucial for meaningful perception.

How we perceive the world around us can be explored using visual illusions, where susceptibility relies on grouping visual information together. Previous behavioral research has established that individuals are susceptible to illusions even when they are unable to report seeing the illusion^{1,2}.

Our aim was to examine the brain regions involved in perceptual grouping during preattentive and divided-attention conditions using functional magnetic resonance imaging.

Methods

Participants

- Fourteen healthy human adults (___ female) with normal or corrected-to-normal vision between the ages of 18-45 years (M = ___)

Task

- Line discrimination task¹
- Completed under preattention and divided-attention conditions.

Acquisition Parameters

- 3T Philips Achieva, 8 channel head coil
- Gradient-echo EPI (TR/TE = 2000/30ms, 179 volumes, voxel size = 3.75 x 3.75 x 4 mm, slices = 30, $\alpha = 90$)

Preprocessing

- Motion correction (MCFLIRT), slice scan time correction, spatial smoothing (FWHM = 5 mm), temporal filtering

Analysis

- Multi-subject RFX GLM (FLAME1)
- Cluster threshold $z = 2.3$, $p(\text{corrected}) = .05$
- FSL

Task Display

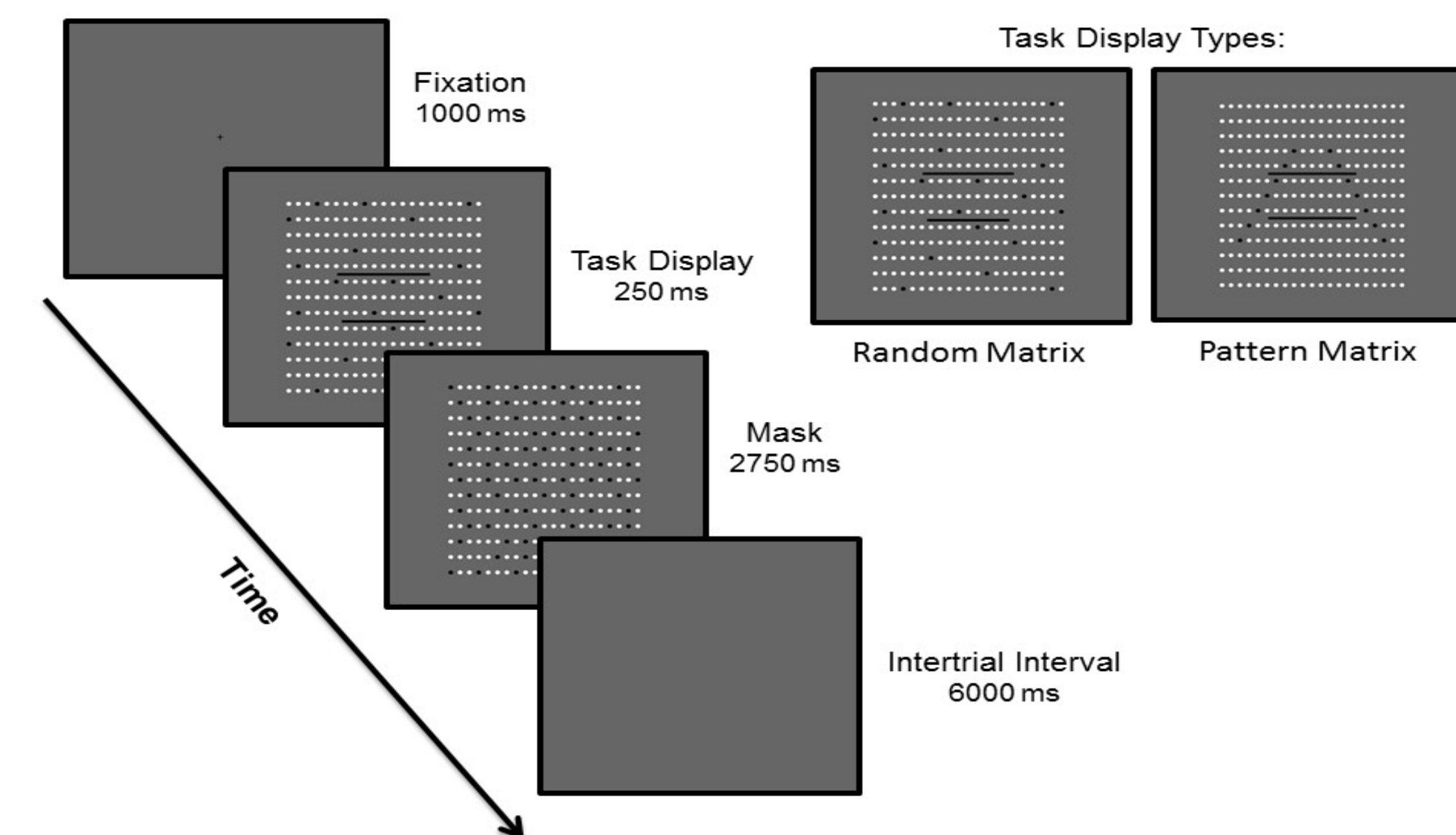


Figure 1. Trial Events. Task display showed either random or pattern trials.

Behavioral Results

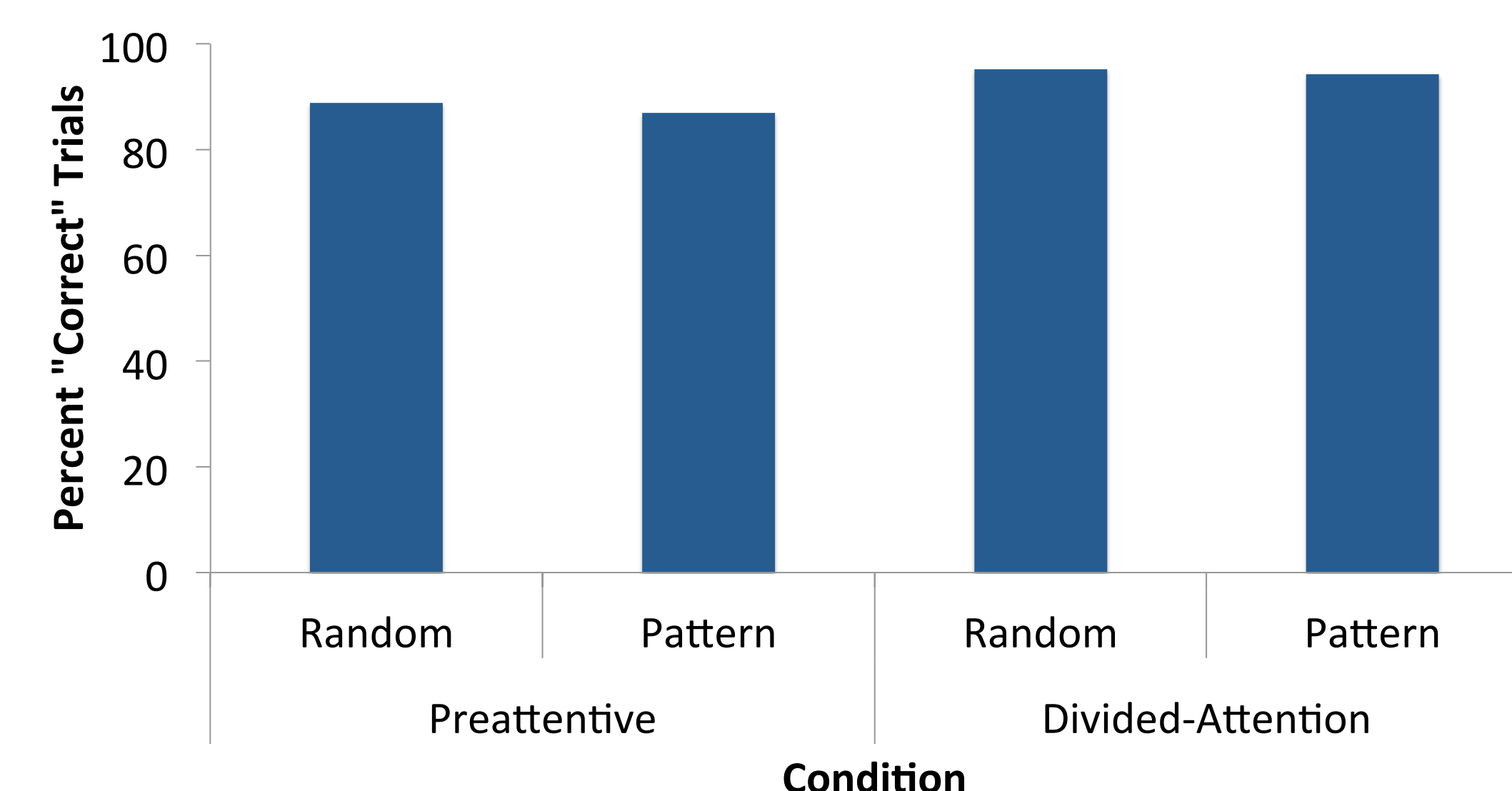


Figure 2. No significant difference in accuracy between pattern- and random-matrix trials in the preattentive ($t(13) = .563$, $p > .05$) or divided-attention ($t(13) = .470$, $p = .646$) conditions

Table 1. Areas differentially activated in illusion vs. random trials.

Location	Side	Brodmann Area	MNI Coordinates			Clusters (Voxels)	p
			x	y	z		
Preattentive Condition:							
Supramarginal gysus (Inferior Parietal Lobe)	L	40	-64	-46	30	817	0.000609
Medial frontal gyrus (Premotor Cortex)	R	6	6	-10	58	523	0.0132
Divided-Attention Condition:							
Lingual Gyrus (Occipital lobe)	R	18	2	-84	-6	3950	1.91E-13
Precuneus (Parietal Lobe)	R	7	18	-68	44	787	0.000923
Precentral Gyrus (Frontal lobe)	R	4	36	-24	56	753	0.00129
Inferior Parietal Lobe	L	40	-36	-54	50	653	0.00356
Medial Frontal Gyrus (Premotor Cortex)	L	32	-4	12	48	561	0.00947

fMRI Results

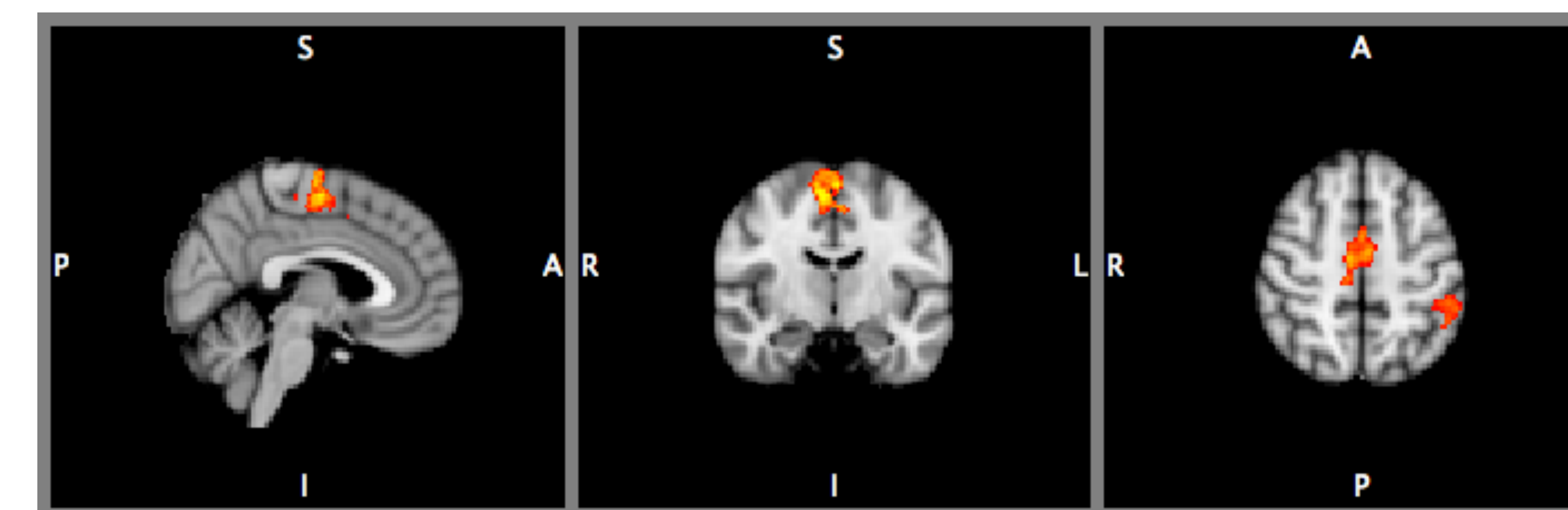


Figure 3. Greater signal changes found in parietal and frontal areas in response to pattern-matrix trials compared to random-matrix trials

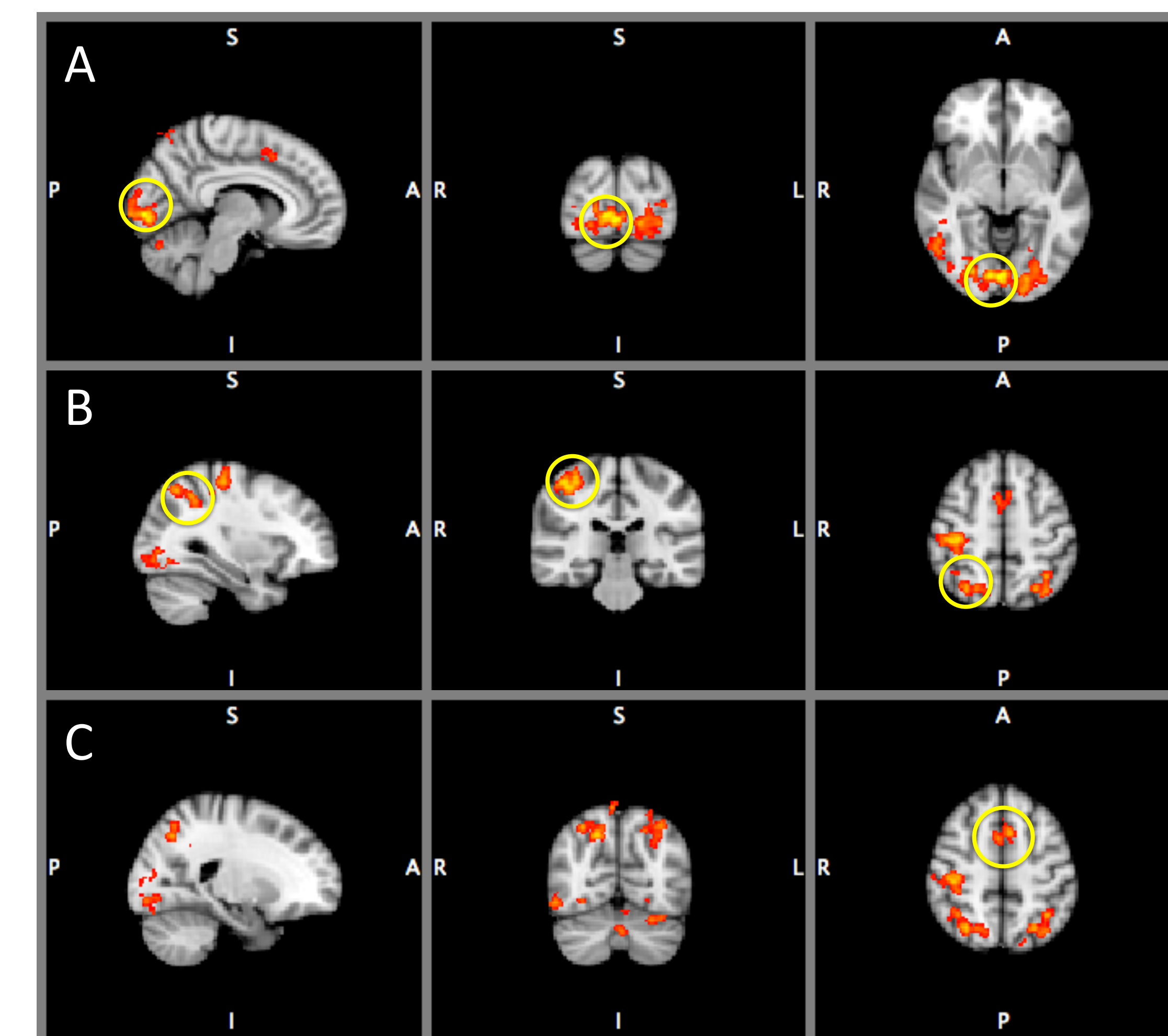


Figure 4. Greater signal changes found in A) right occipital, B) right parietal and C) right frontal areas in response to pattern-matrix trials compared to random matrix trials (yellow circles)

Conclusion

- Figure perception generated greater activation in visual cortex only under divided-attention condition
- Greater activation in precuneus during divided-attention condition may reflect shifts of attention due to more attentionally demanding task
- Recruitment of middle frontal gyrus may reflect reorientation of attention³ and recruitment of higher brain regions to aid perceptual grouping
- Activation in preattentive condition differed from divided-attention condition, suggesting that attention alters the brain networks responsible for figure processing

References

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2. Carther-Krone, T.A., Shomstein, S., & Marotta, J.J. (2016). Looking without perceiving: Impaired preattentive perceptual grouping in Autism Spectrum Disorder. *PLoS ONE*, 11(6), e0158566
3. Japee, S., Holiday, K., Satyshur, M.D., Mukai, I., & Ungerleider, L. (2015). A role of right middle frontal gyrus in reorienting of attention: A case study. *Front. Syst. Neurosci.*, 9, 1-16.

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