

Dysrupted modulation of thalamocortical connectivity during task performance in schizophrenia.

Anna S. Huang¹, Baxter P. Rogers², Neil D. Woodward¹

¹ Department of Psychiatry and Behavioral Sciences, Vanderbilt University Medical Center

² Vanderbilt University Institute of Imaging Sciences

Background

- Higher-order cognitive abilities are impaired in schizophrenia¹.
- Higher-order cognitive abilities are supported by a distributed network that includes the prefrontal cortex (PFC) and thalamus^{2,3}.
- While dysfunction of the thalamus is well-established in schizophrenia, few studies have investigated thalamus activation and thalamocortical modulation by cognitive demand.
- To address this gap, we investigated how thalamus function and thalamus-PFC connectivity under different levels of cognitive demand may be disrupted in schizophrenia.

Methods

Table 1. Sample Demographics

Variable	CON n=19	SCZ n=20	Statistics		
Sex (M/F)	8:11	10:10	t/x ²	df	p
Ethnicity (W:AA)	14:5	12:8	.82	37	.365
	Mean	SD	Mean	SD	
Age	41.05	8.8	40.45	11.9	0.18 37 0.858
Education	16.42	2.1	13.80	2.3	3.72 37 <.001
Maternal Education	12.74	2.2	13.16	3.3	-0.47 36 0.642
Paternal Education	13.84	3.3	13.16	4.1	0.57 36 0.573
PANSS Positive	--	--	13.8	6.1	-- -- --
PANSS Negative	--	--	14.7	5.6	-- -- --
PANSS General	--	--	26.9	7.8	-- -- --
CPZ equivalent	--	--	387	262.3	-- -- --

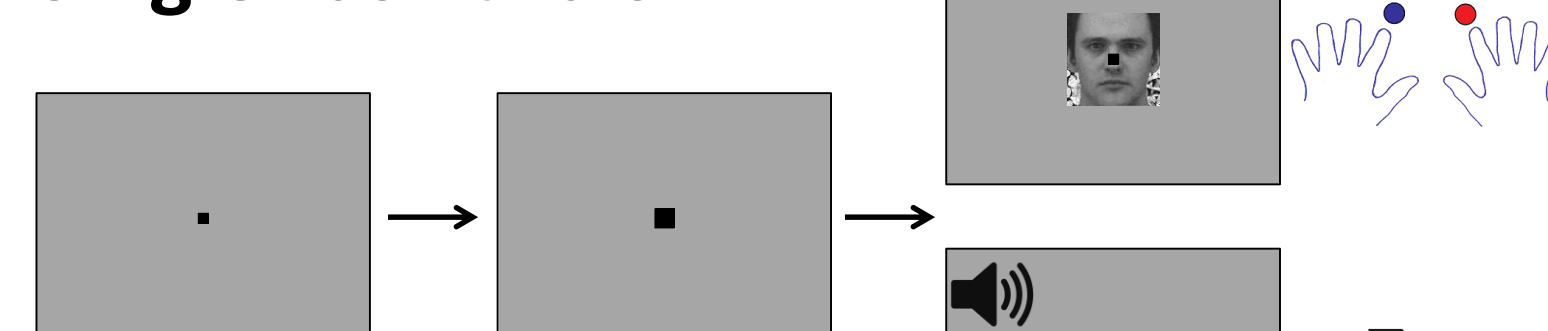
Scanning Included:

- T1 Structural (3D MPRAGE; FOV = 256x256x170 sagittal slices; Resolution = 1x1x1 mm).
- 5 Event-Related Dual-Task Paradigm⁴ functional EPI runs (TR = 2000; FOV = 80x80x38 axial slices; Resolution = 3x3x3.3 mm; Volumes 203/run).

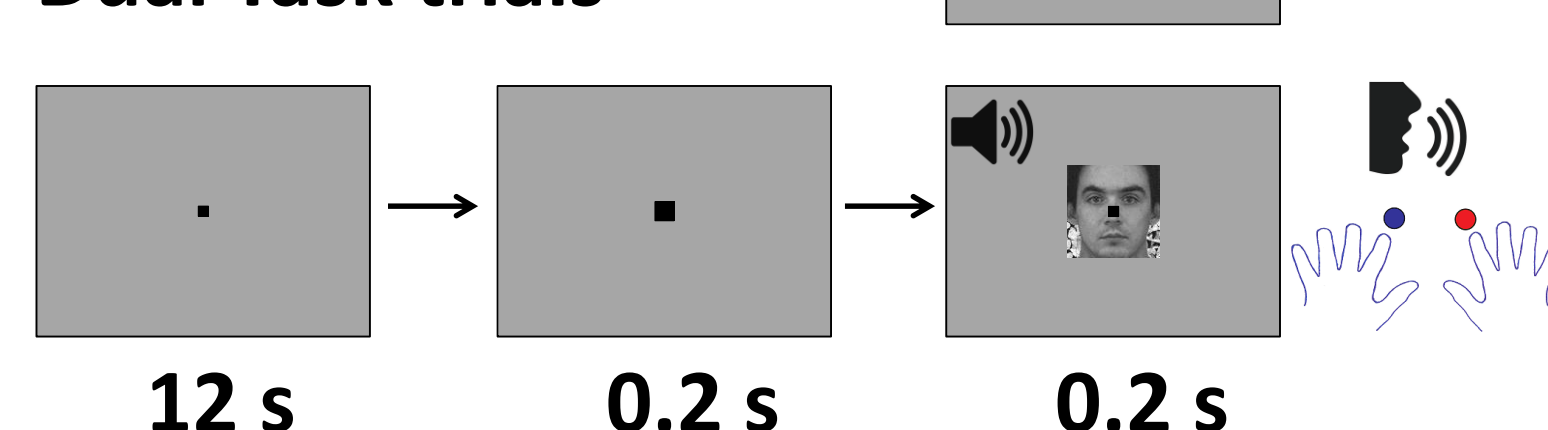
Analyses:

- Prefrontal and mediodorsal thalamus and pulvinar (Morel atlas⁵) activation in Dual > Single Contrast for healthy individuals (CON) and individuals with schizophrenia (SCZ).
- Task connectivity was measured using beta-series connectivity seeded from an area within the thalamus that showed significant group by condition interaction.

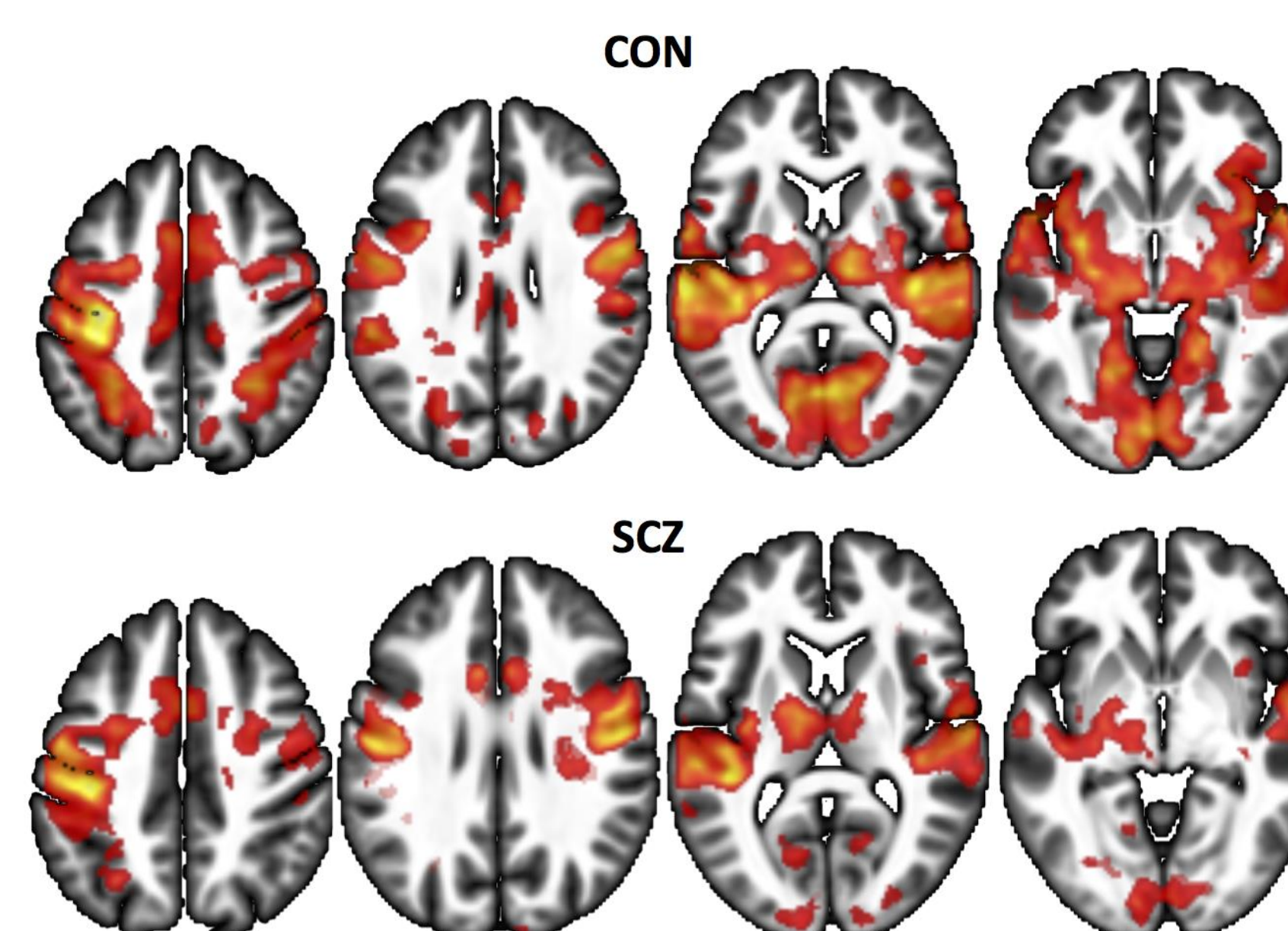
Single Task trials



Dual Task trials

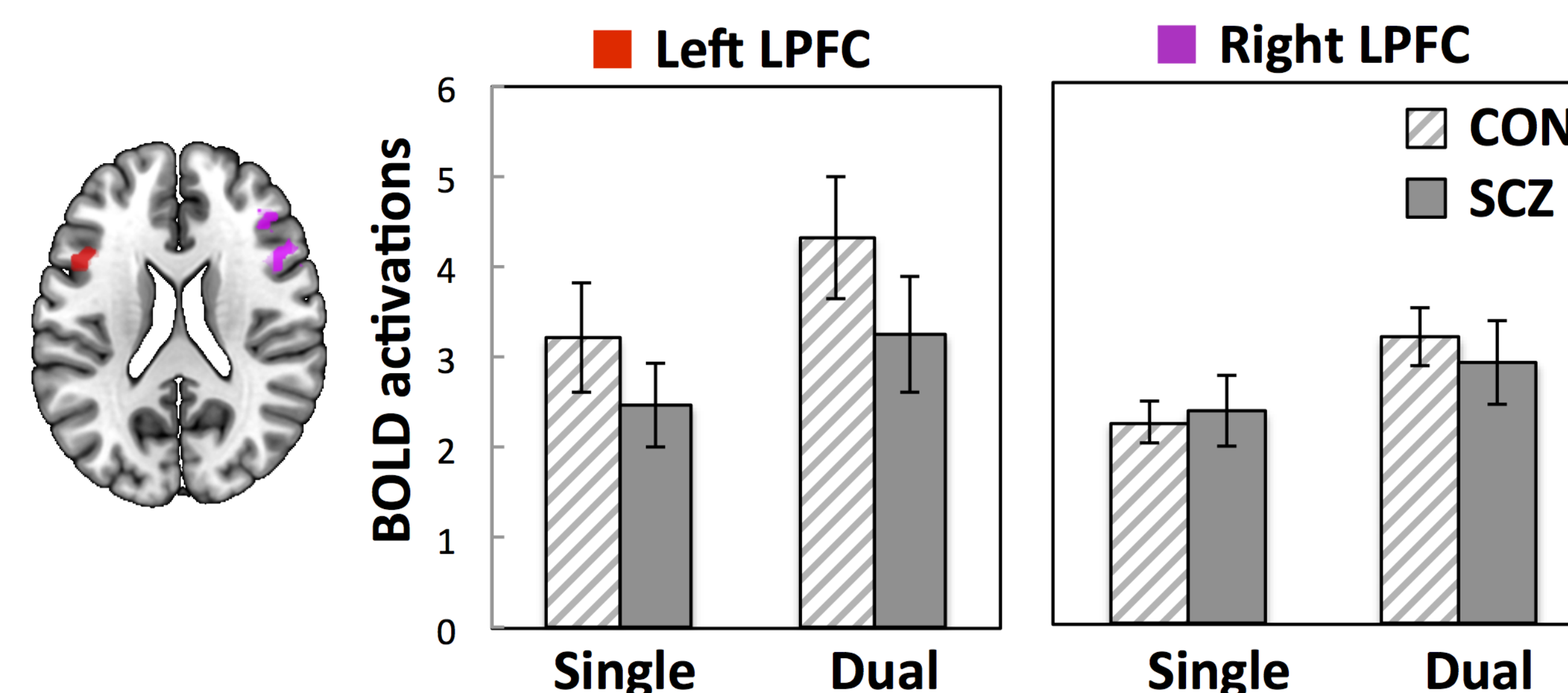


Whole Brain Dual > Single Contrast

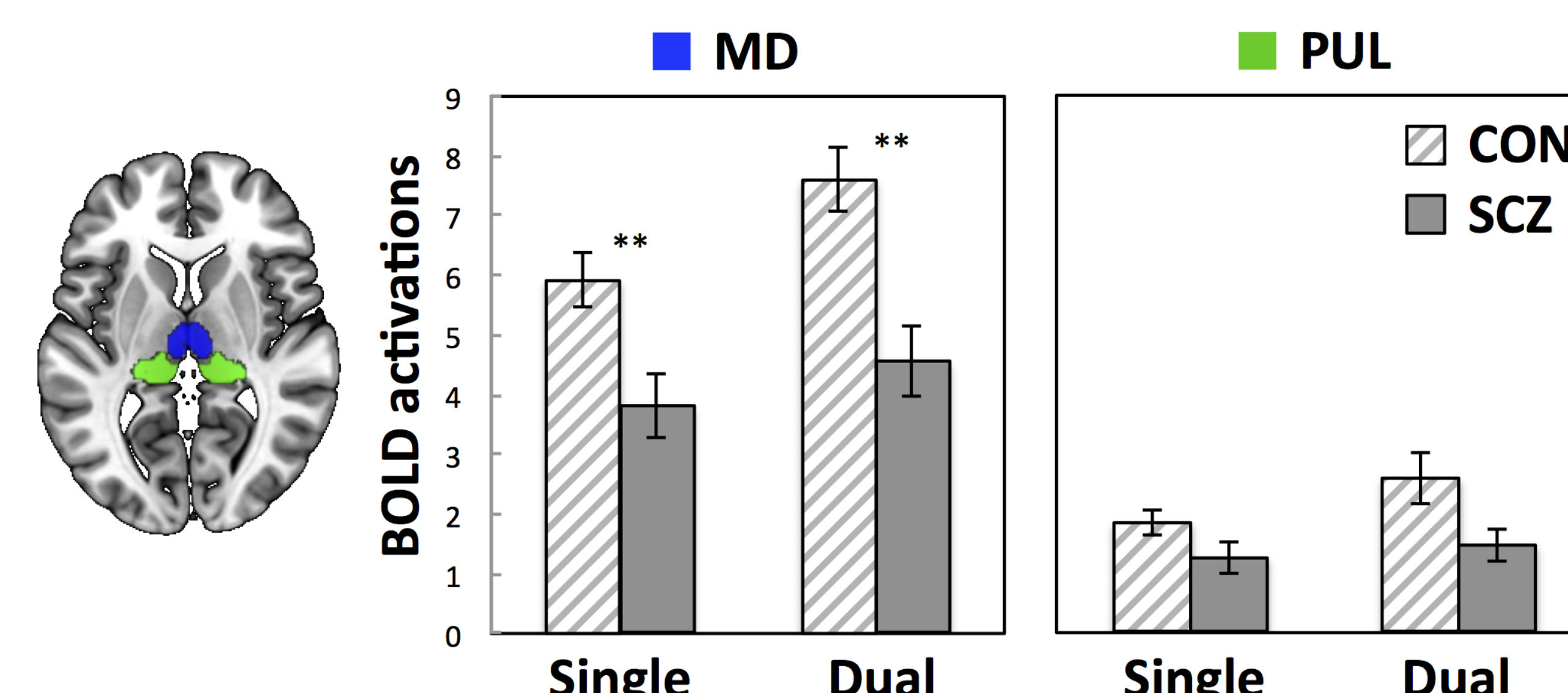


Both groups showed significantly greater activation in the Dual compared to Single task condition in a set of frontoparietal, sensorimotor and thalamic regions.

Prefrontal and Thalamus Activations



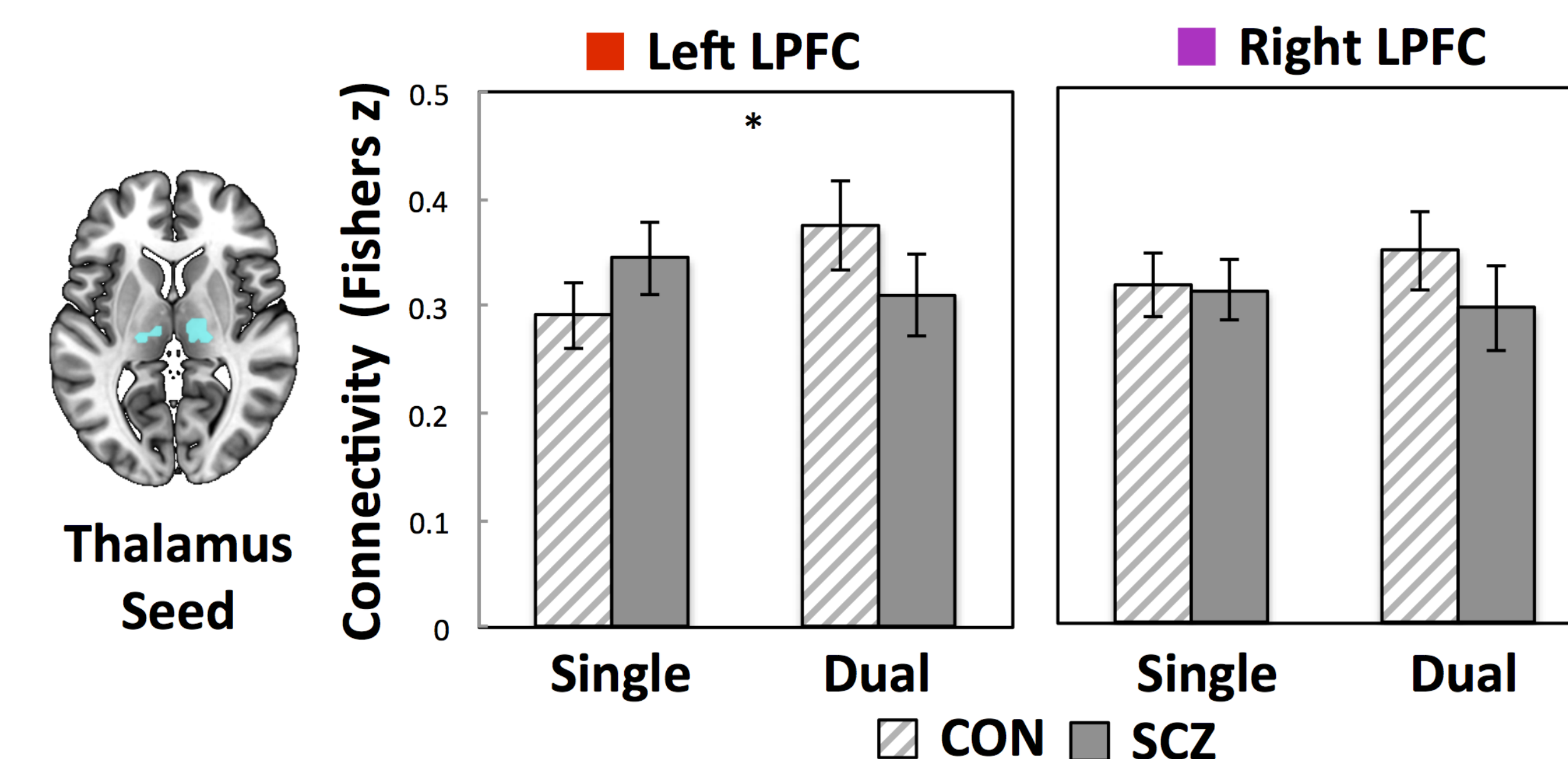
The lateral prefrontal cortex (LPFC) did not show significant group or interaction effects.



The mediodorsal thalamus (MD) showed significantly greater group differences ($F(1,37) = 12.28$, $p < 0.01$), but not interaction effect. The pulvinar (PUL) did not show significant group or interaction effects. Both thalamus ROIs showed significant condition effects (MD: $F(1,37) = 29.25$, $p < 0.001$; PUL: $F(1,37) = 9.41$, $p < 0.05$)

Results

Thalamus-Prefrontal Connectivity



Connectivity between the thalamus and the left lateral prefrontal cortex (LPFC) showed a significant interaction ($F(1,37) = 10.23$, $p < 0.05$) such that healthy individuals (CON) showed significantly increased connectivity from Single to Dual task condition, whereas schizophrenia patients (SCZ) did not. The right LPFC showed no significant condition, group or interaction effects.

Table 2. Behavioural Data

	CON		SCZ	
	Single	Dual	Single	Dual
Accuracy	90.2±10.1	87.7±11.4	87.8±14.0	84.3±16.5
Reaction Time	1062±157	1374±233	1203±169	1461±242

Accuracy showed significant Condition effects ($F(1,37) = 12.78$, $p < 0.001$), but not significant group or interaction effects. Reaction Time showed significant Condition ($F(1,37) = 195.68$, $p < 0.001$) but not group or interaction effects.

Conclusions

- Reduced thalamus activation was observed in schizophrenia, though PFC function appeared to be better preserved for this task.
- Reduced modulation of thalamocortical connectivity with cognitive demand was observed in schizophrenia.
- Future investigations should extend cognitive demand parametrically to examine non-linear effects of thalamus function and thalamocortical connectivity in schizophrenia.

References

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