

Drawing on the Right Side of the Brain: A VBM study of drawing and local processing ability

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Background

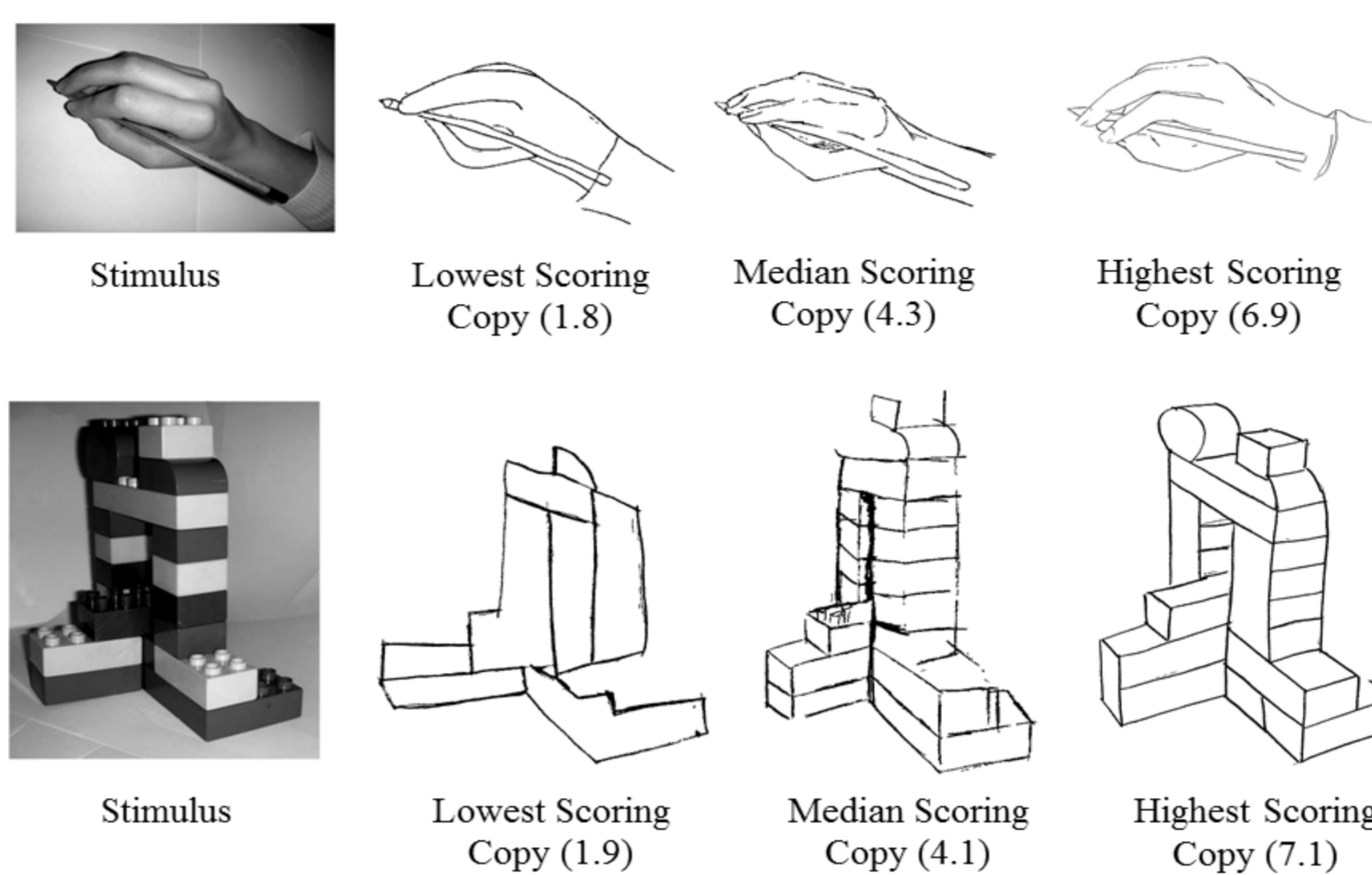
- Neuropsychological and neuroimaging research in drawing implicates the integration of multimodal perceptual data, largely involving the parietal cortices (Solso, 2001; Makuuchi et al., 2003; Miall et al., 2009)
- Novices who taught an intensive art course showed functional changes in the right cerebellum whilst performing gestural drawing (Schlegel et al, 2012)
- A behavioural link exists between local processing ability and drawing ability (Drake & Winner, 2011; Chamberlain et al, 2013).
- Aim - To investigate differences in brain structure in relation to increasing representational drawing skill and local processing.
- Hypotheses:
 1. Better draftsmen will show increased GM and WM in parietal, cerebellum and motor regions.
 2. There will be overlap in brain regions associated with local processing tasks and drawing tasks.

Participants

- Artists and non-artists (N=44, 30 female, mean age=25.9 (SD=6.5)). Artists spent average 2 hours per week drawing over last 2 years.

Drawing Tasks

- 10 judges rank drawings (Cronbach's alpha=.92)



Local Processing Tasks

- **Embedded Figures Task (below left)** - Find a simple shape within a more complex shape.
- **Block Design Task (below right)** - Replicate block designs as quickly as possible.

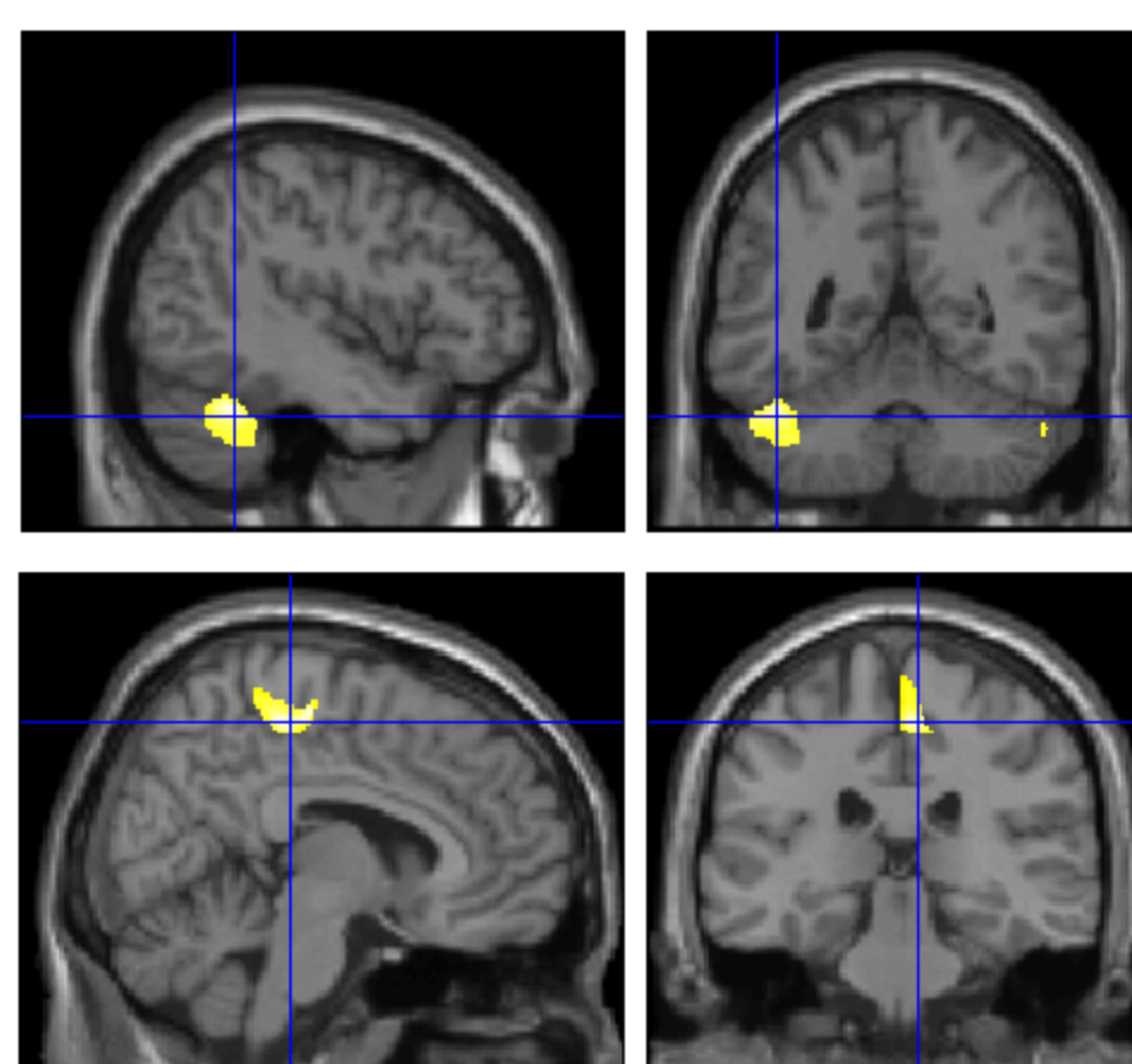


Neuroimaging Analysis

- Whole-brain MR images obtained using a T1-weighted three-dimensional sequence
- MPRAGE; rep time=2.73s; echo time=3.57 ms; voxel size=1×1×1 mm.
- MR images segmented for grey matter (GM) and white matter (WM) in SPM8
- Pre-processed images entered into multiple regression models in SPM5 to identify cortical regions that showed correlations with:
 1. Drawing ability
 2. Local processing ability

GM Volume and Drawing Ability

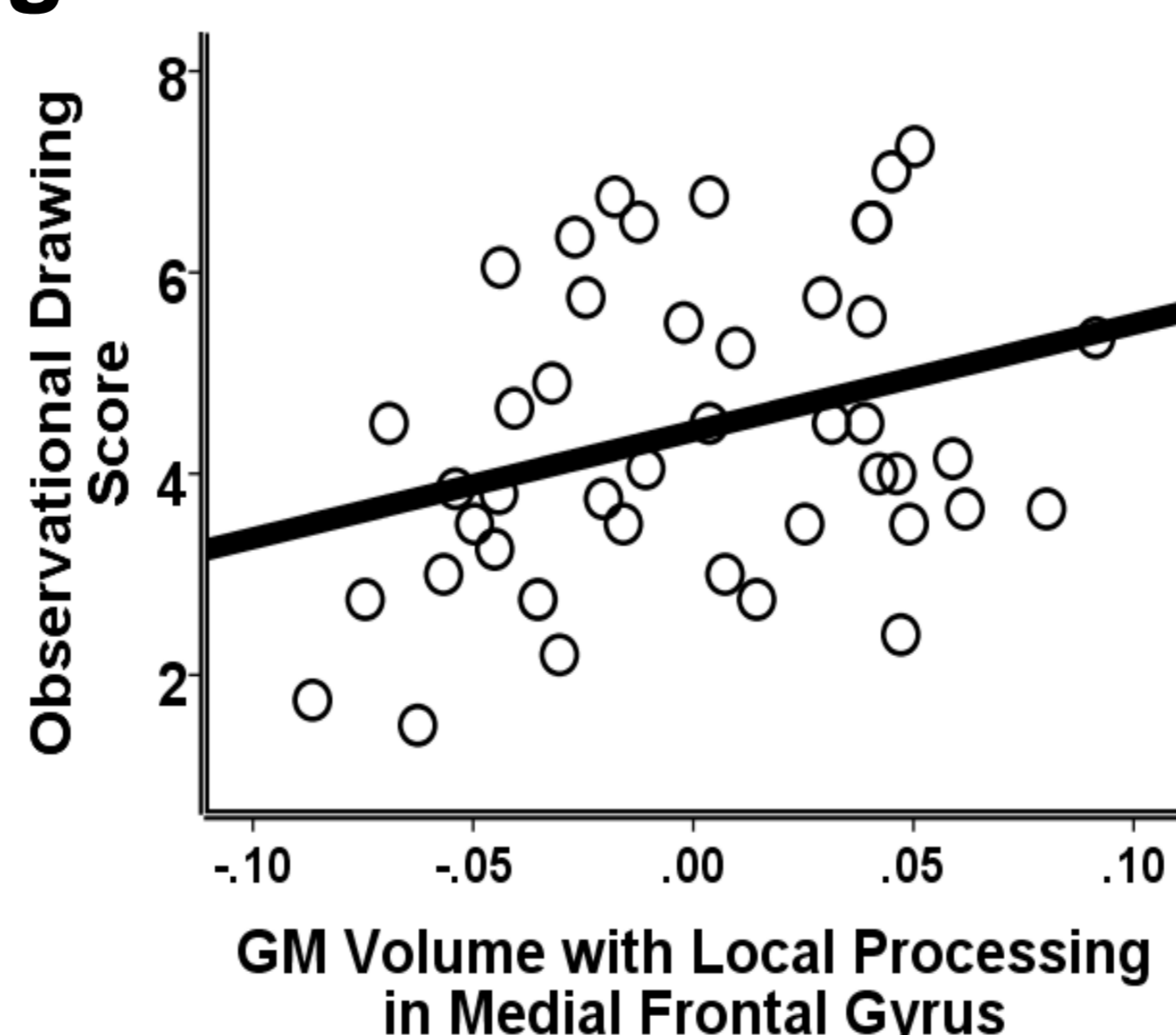
- Artists' drawing ratings were on average 1.42 points higher than non-artists, $t(42) = 3.51, p < .01$.
- Significant correlations between GM and drawing accuracy found in the left cerebellar cortex (whole-brain corrected, $p < .05$) and the right medial frontal gyrus (whole-brain uncorrected, $p < .05$; see table).



	Anatomy (Brodmann Area)	MNI coordinates			Cluster Size (mm ³)	Z	P _{uncorr}	P _{corr}
		X	Y	Z				
Drawing	Left Anterior Cerebellum	-44	-51	-28	935	3.99	.00	.00
	Right Medial Frontal Gyrus (BA 6)	8	-25	56	288	4.17	.02	.18
Local Processing	Right Medial Frontal Gyrus (BA 6)	6	-22	57	688	4.48	.00	.02
	Left Middle Temporal Gyrus (BA 22)	-59	-43	3	571	4.20	.01	.04

Overlap of Local Processing and Drawing

- Local processing positively correlated with drawing ability, $r(44) = .66, p < .001$.
- GM in right medial frontal gyrus and left middle temporal gyrus (whole-brain corrected $p < .05$) correlated with local processing ability (see table).
- There was a significant correlation between GM volume in the right medial frontal gyrus associated with local processing ability and drawing accuracy scores, $r(44) = .32, p < .05$.



Discussion

- An increase in GM volume in the cerebellum was observed in relation to drawing ability, suggesting an enhancement of fine motor control and procedural memory.
- A region of right medial frontal gyrus was associated with both local processing and drawing.
- Medial frontal involvement during local processing may reflect suppression of the bias toward global perceptual processing, based upon this region's role in conflict resolution in other studies (Lux et al, 2004).
- Overlap in medial frontal regions on local processing tasks and drawing suggest that both may be facilitated by the suppression of bias toward global perceptual processing in action selection.

References

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