



In vitro layer-specific Diffusion Weighted Imaging in human primary visual cortex

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NVvTG

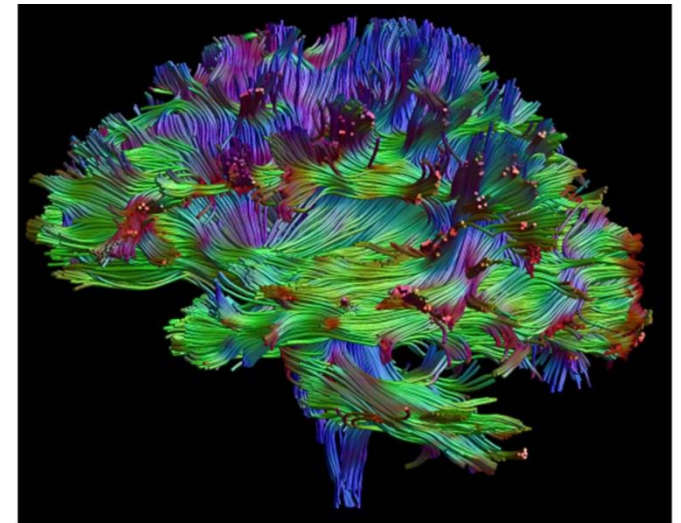
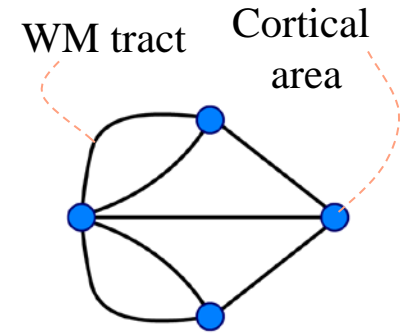
Woerden, 21 October 2011

VIP Brain Networks



Networks...

- WM circuitry investigated with DWI:
- DWI tractography → anatomical networks
- Network analysis in disease
 - **Stroke** (Crofts et al., NI2011)
 - **AD** (He et al., JNS 2008)
 - **Schizophrenia** (Basset et al., JNS 2008)

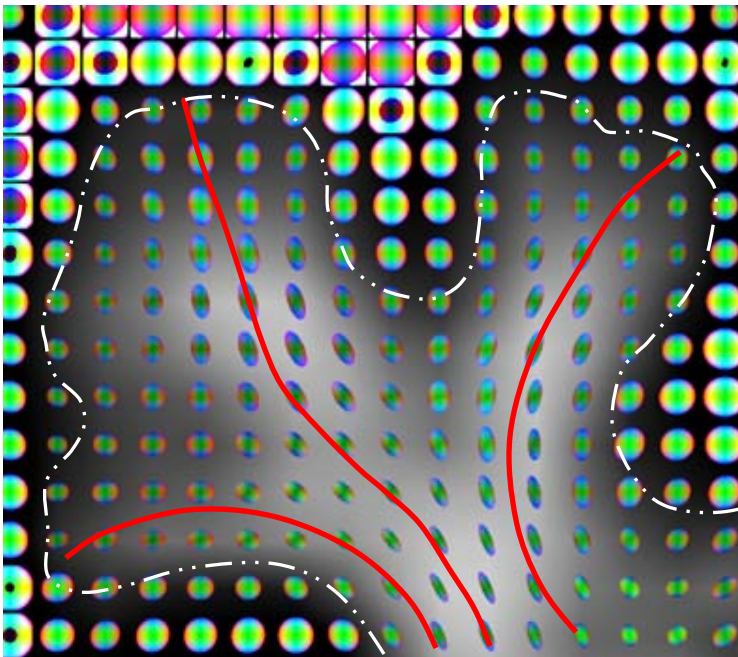


Anisotropy

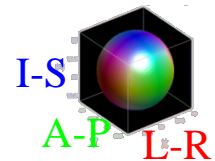
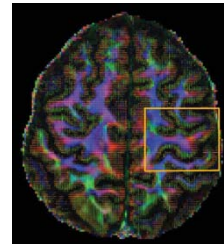
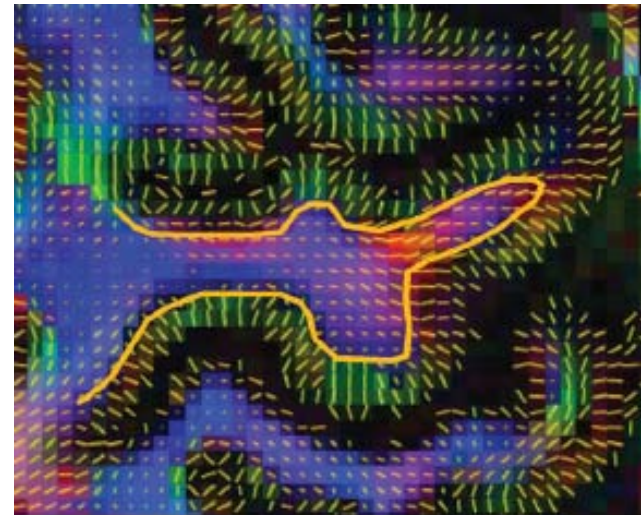
“In the cortex, diffusion is ~~isotropic~~ *anisotropic*”

2 mm voxels

GM



1 mm voxels (7T system)



Heidemann et al., MRM 2010

Sikma, K-J., Thesis defense, May 2011

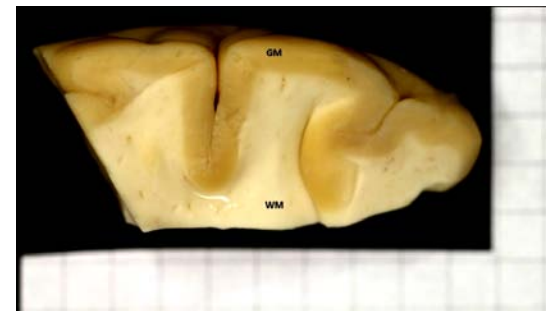
WM

Hypothesis

- Cortical layers can be distinguished on the basis of their diffusion properties
- The stria of Gennari (V1) has a large tangential diffusion component

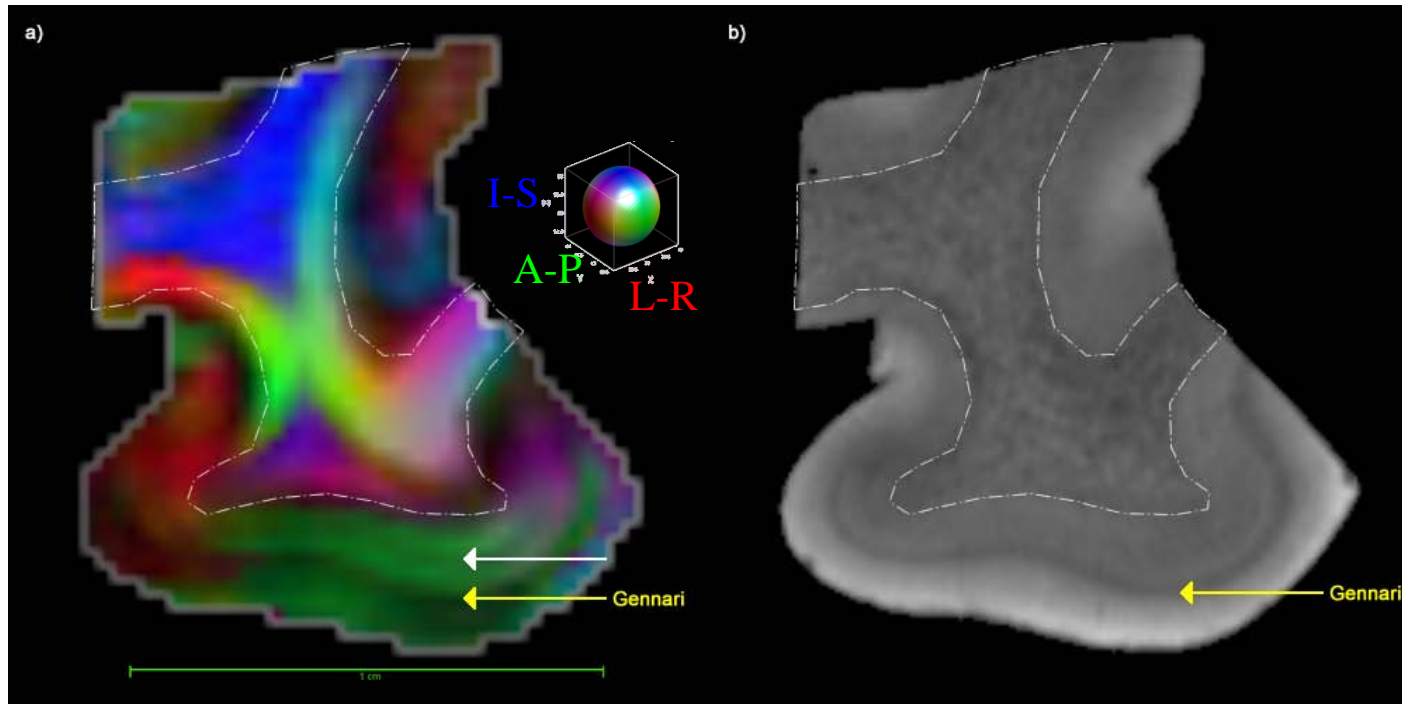
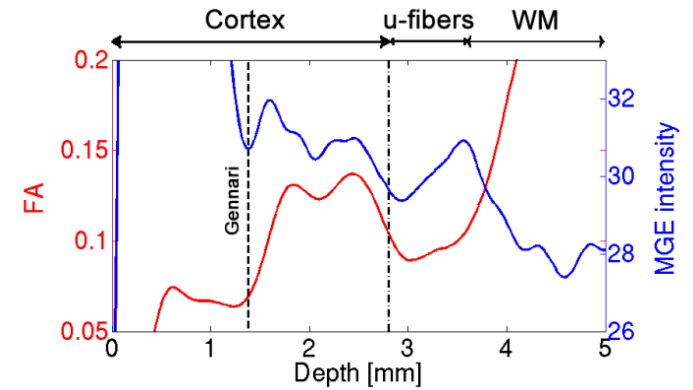
Methods: MRI

- Human brain tissue samples (1 × 1 × 3 cm)
 - Cortex (V1) + WM;
 - post-mortem interval 15h
- MRI: 11.7 T animal system
 - ▣ DWI – 0.3 mm isotropic
 - ▣ Anatomical – 0.1 mm isotropic
- Histology: myelin stain, Luxol Fast Blue



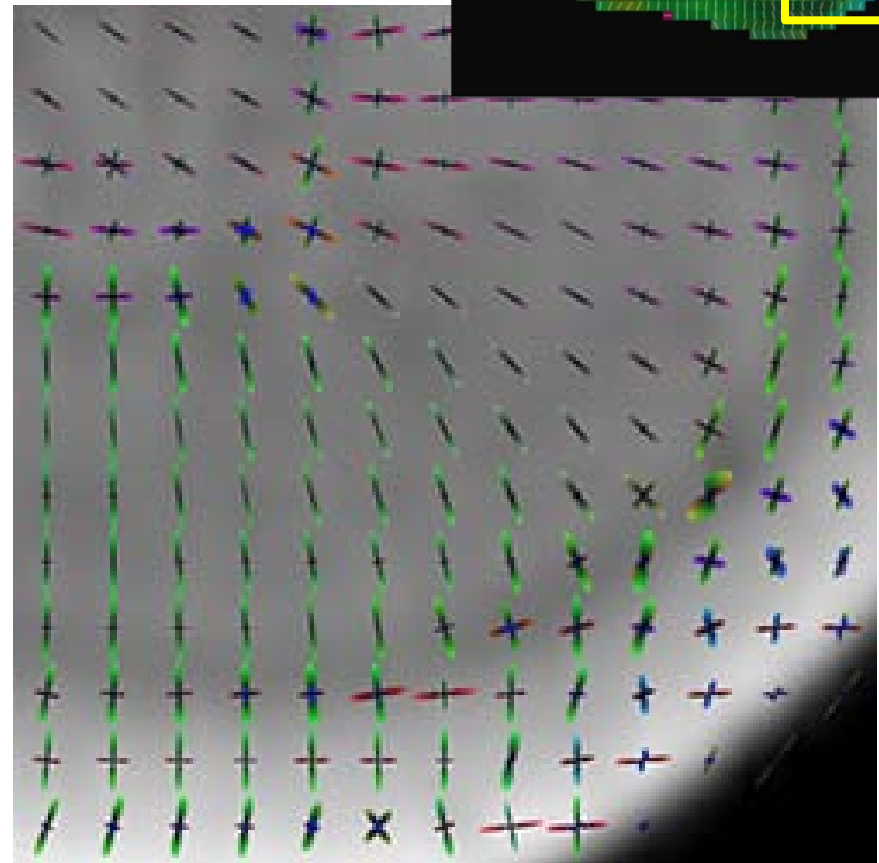
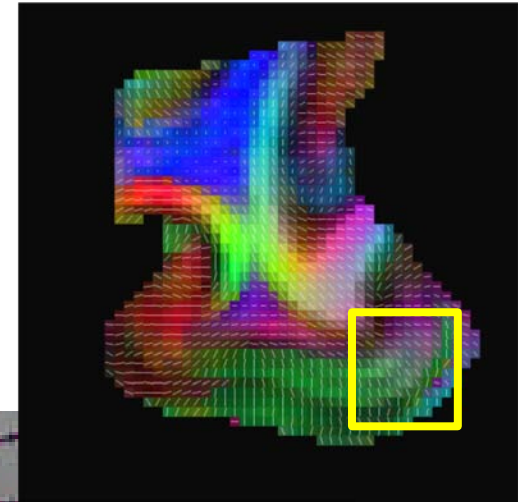
Results I: Fractional Anisotropy

- FA is non-uniform over layers

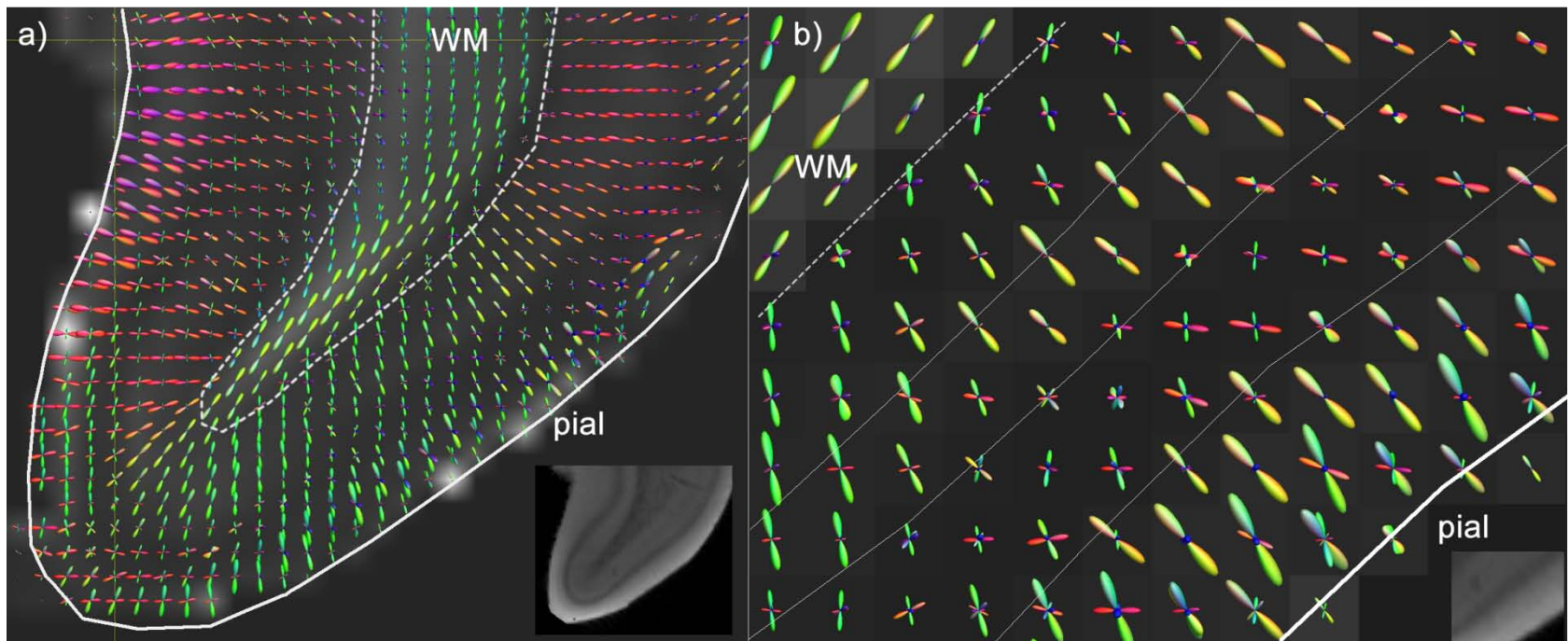


Results II: diffusion directions

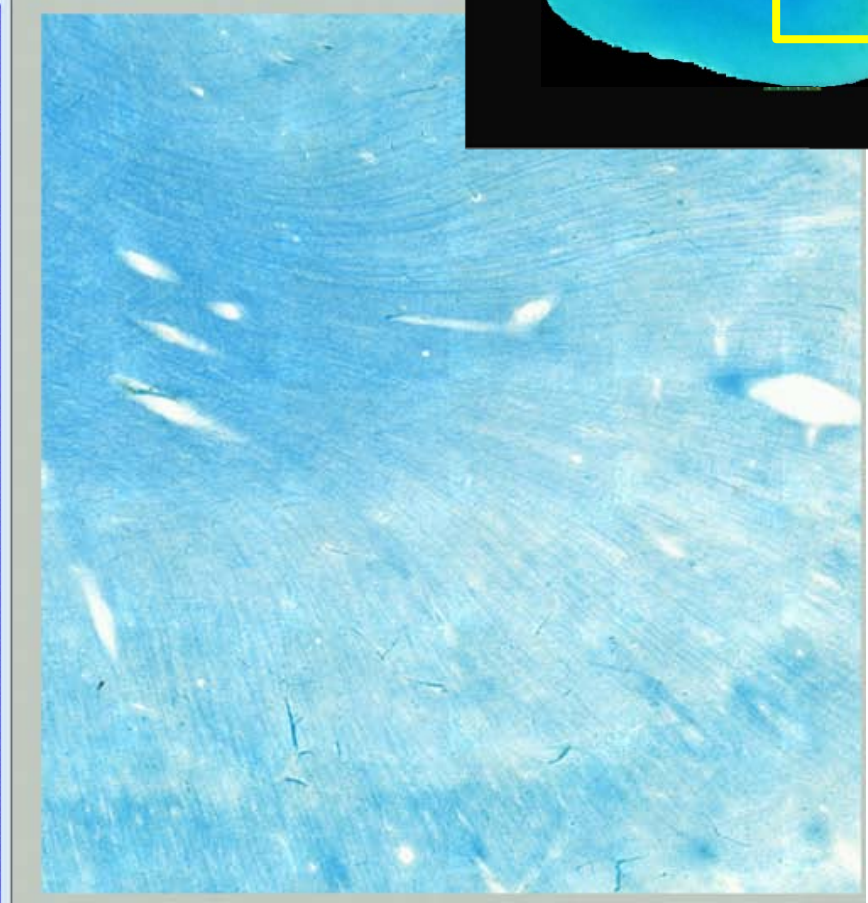
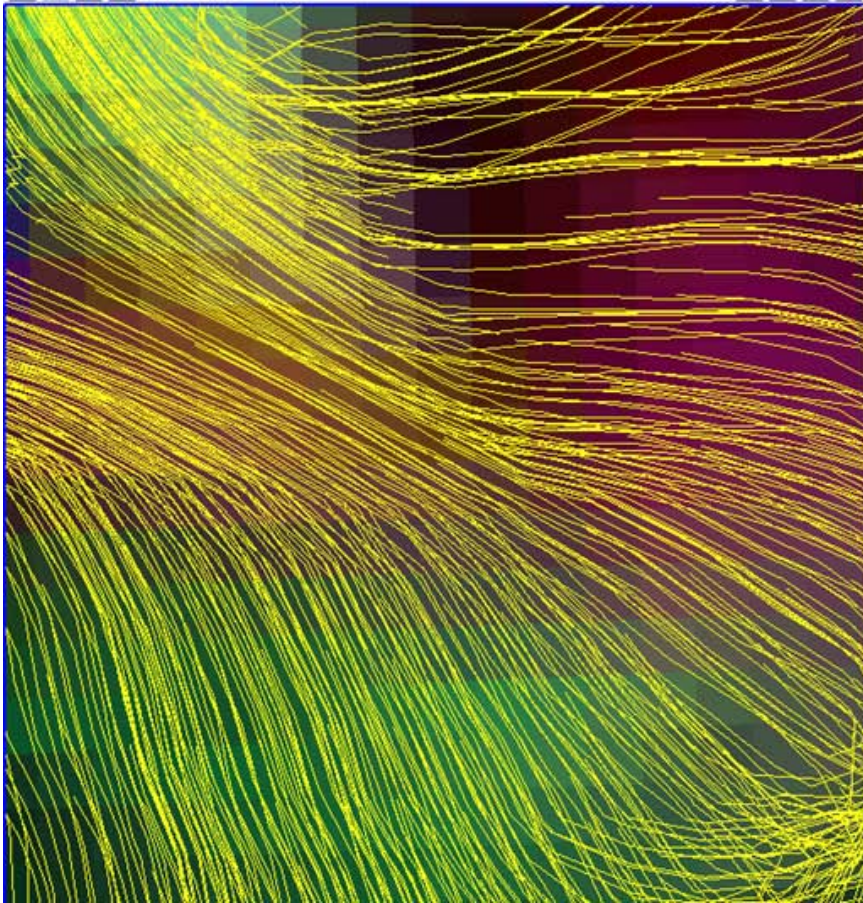
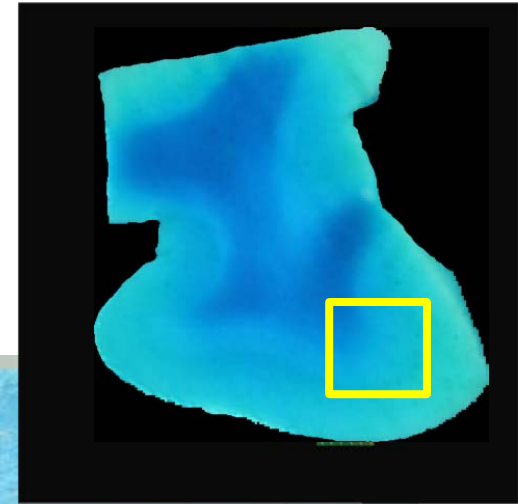
- WM
- U-fibers
- Deep cortical layers
- Gennari
- Superficial layers
- layer I fully tangential



Results II: diffusion directions



Results III: tractography and histology



Discussion and conclusion

- Our findings are a first step in understanding diffusion properties within the cortex
- Usefulness for tractography and networks?
 - ➔ informative for cortical endpoints
 - ➔ presumed isotropic tangential component within layers

anisotropic and layer-specific
“In the cortex, diffusion is ~~isotropic~~”

Thanks!

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Radiology: Andor Veltien

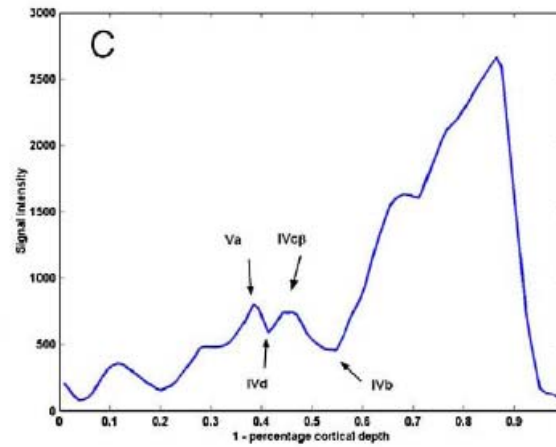
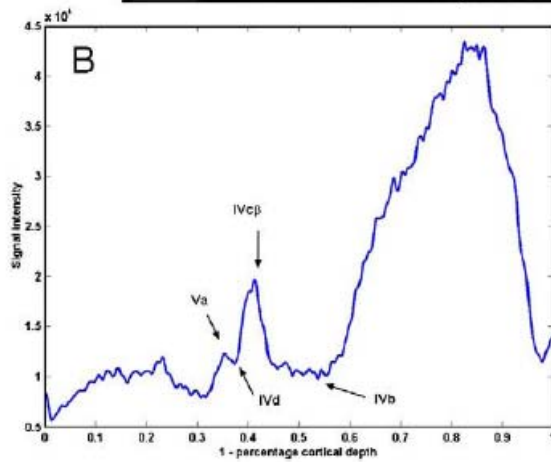
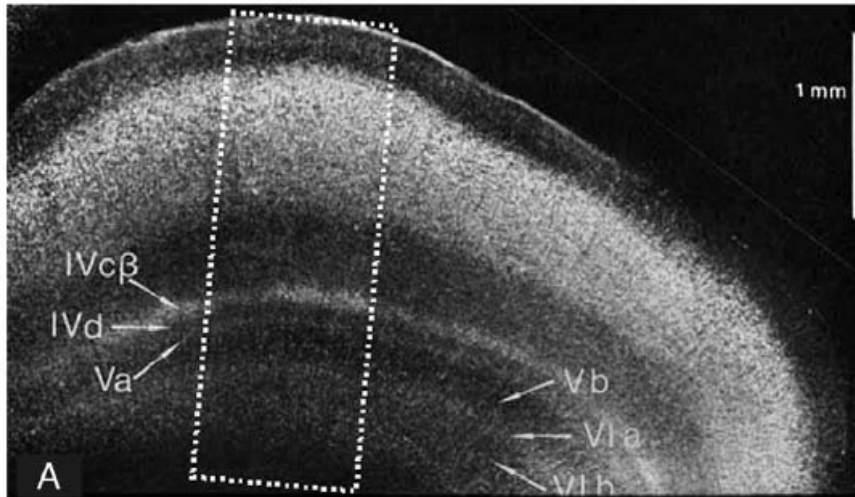
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VIP Brain Networks

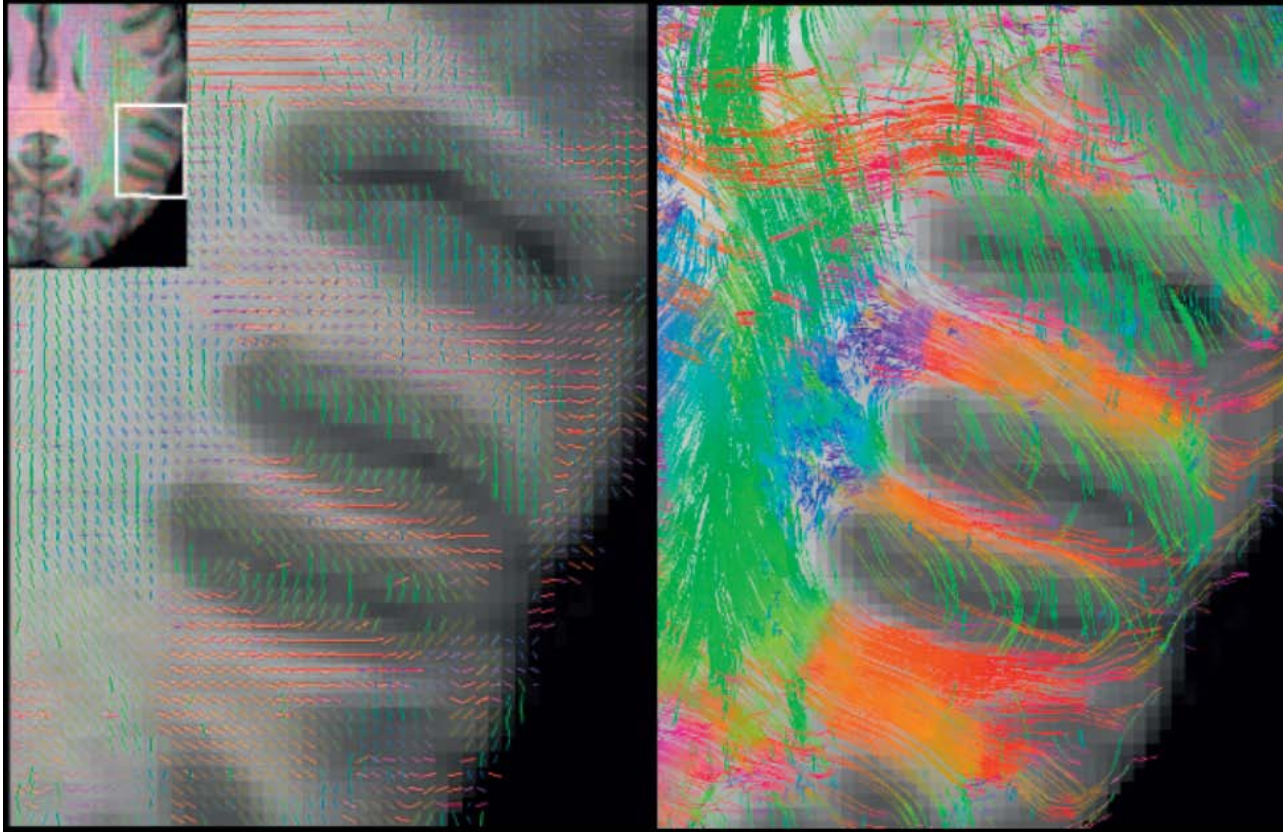


Additional



Blackwell et al., NI 2009

Additional



Heidemann et al., ISMRM 2011, P1957