



# **Big Data: Pipeline Demo Day**

## Analysis of white matter shapes

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# Summary



- ▶ White matter morphology and Alzheimer's
- ▶ LONI Pipeline / methodology
- ▶ Results



# A problem for Pipeline

- ▶ **Alzheimer's disease**

- ▶ Modest delay of onset → significant positive impact
- ▶ Importance of finding earliest markers

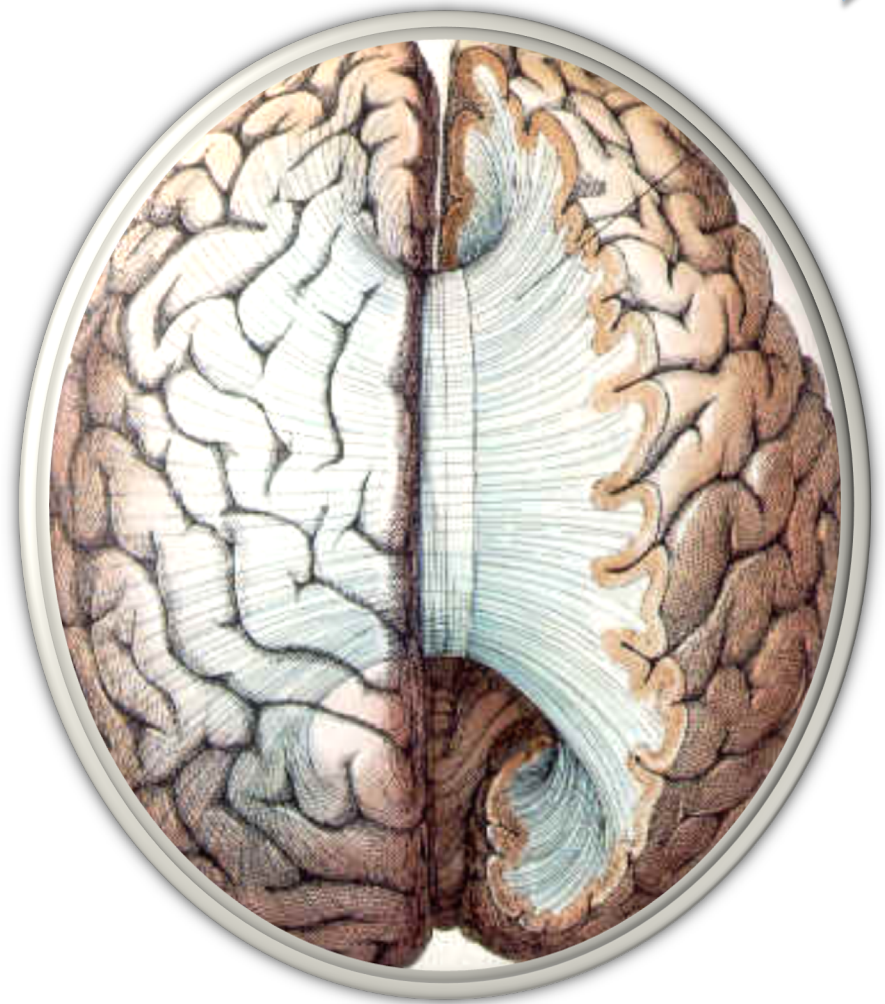
- ▶ **Classically a GM disease**

- ▶ Association with altered WM

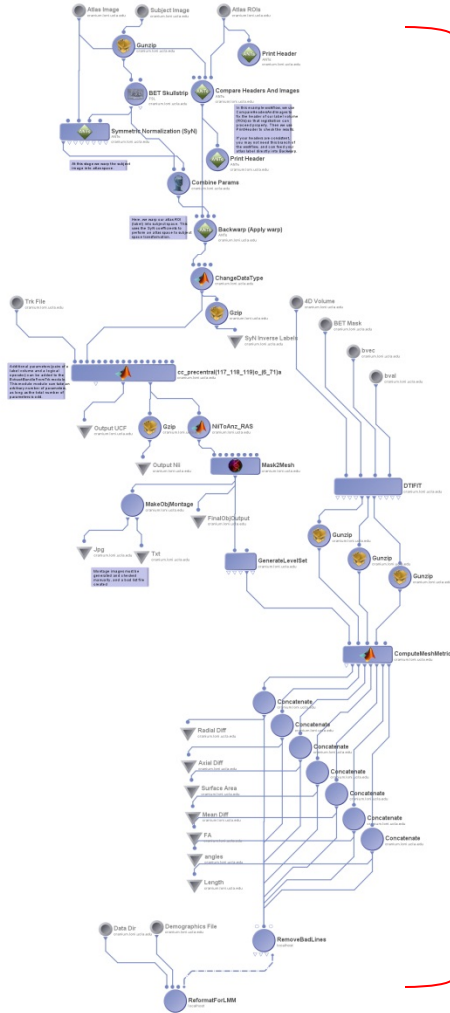
- ▶ **The Question:** How do the **shapes** of particular fiber bundles vary between different groups of people? Normal aging? Alzheimer's?

# The goal

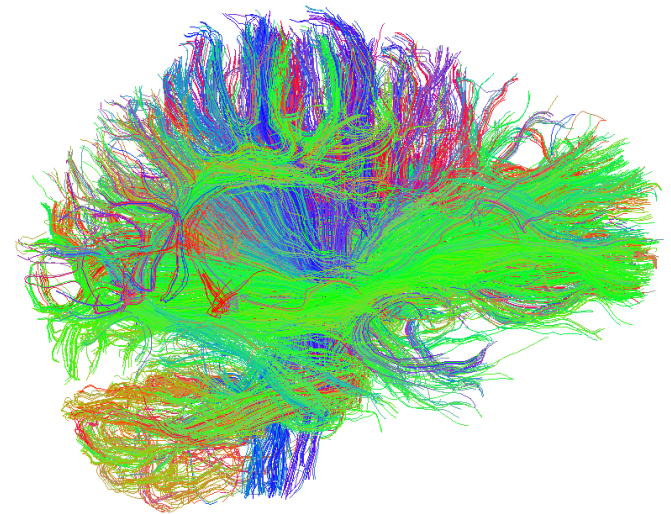
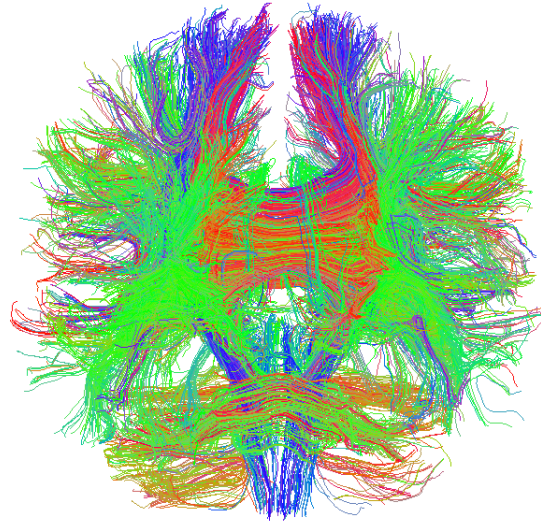
- ▶ Find a way to:
  - ▶ Isolate target fiber bundles from subjects (DTI, tractography)
  - ▶ Represent these bundles as geometric shapes (Triangular mesh wrapping)
  - ▶ Perform comparisons between subjects (multilevel modeling)
- ▶ **Pipeline** automation



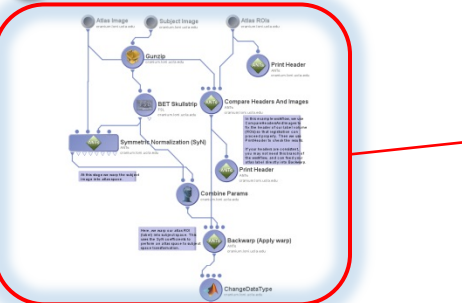
# Pipeline automation



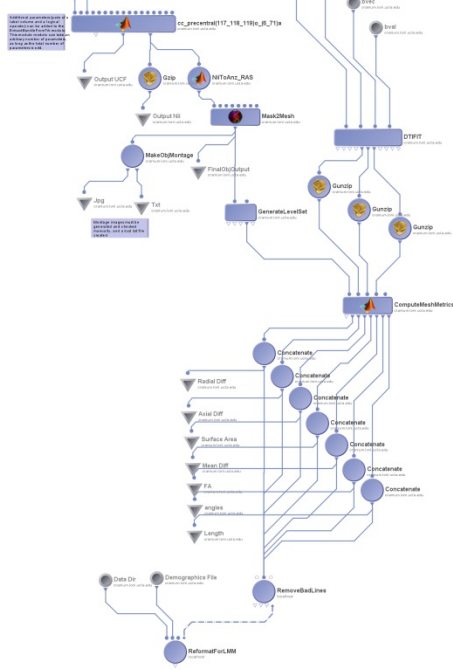
- **Starting point: DICOM**
- **Tractography**
- Data preprocessing
- Bundle extraction, surface computation and visualization
- Surface measurement
- Output to SPSS



# Pipeline automation

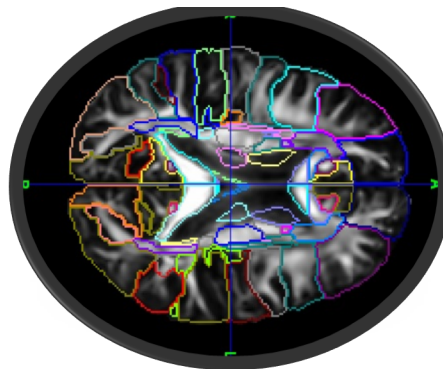


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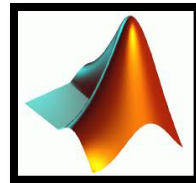
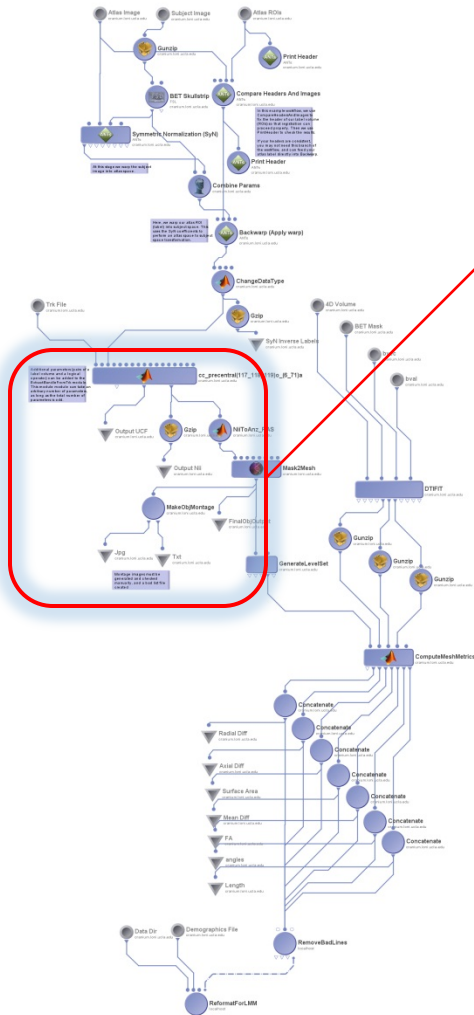
## Advanced Normalization Tools

- Nonlinear registration of an atlas + ROI labels to each subject

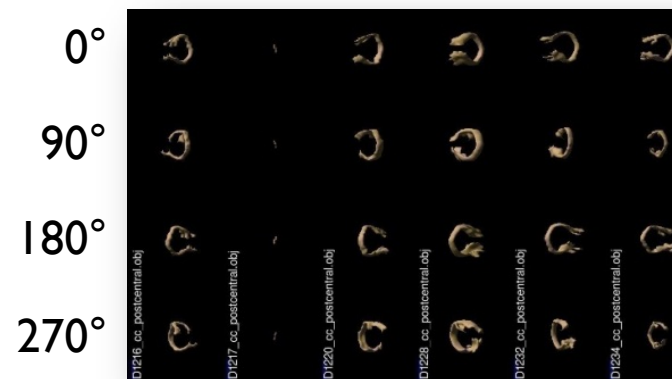


# Pipeline automation

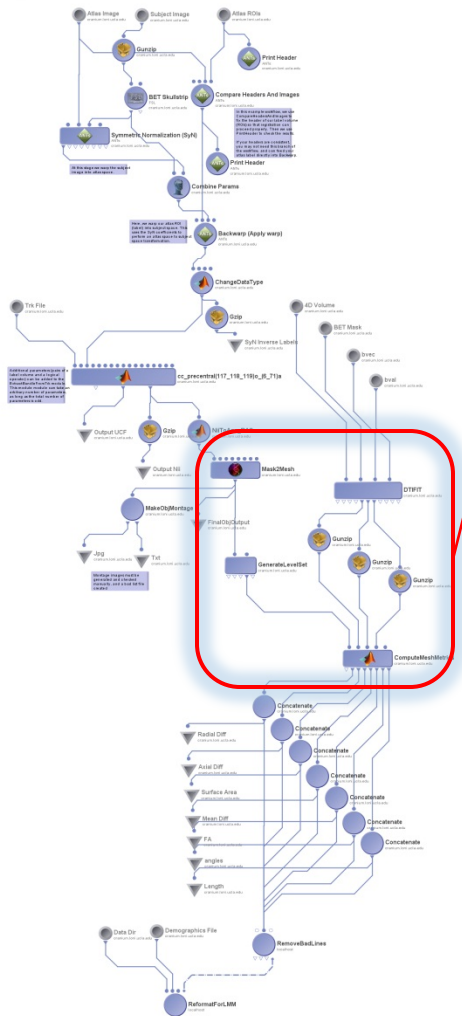
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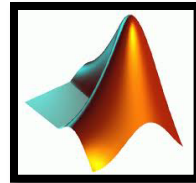
- Define a portion of wholebrain tractography (“the bundle”)
- Wrap the bundle with a triangular mesh
- Visualize the results:



# Pipeline automation



- Starting point: DICOM
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- Data preprocessing
- Bundle extraction, surface computation and visualization
- **Surface measurement**
- Output to SPSS

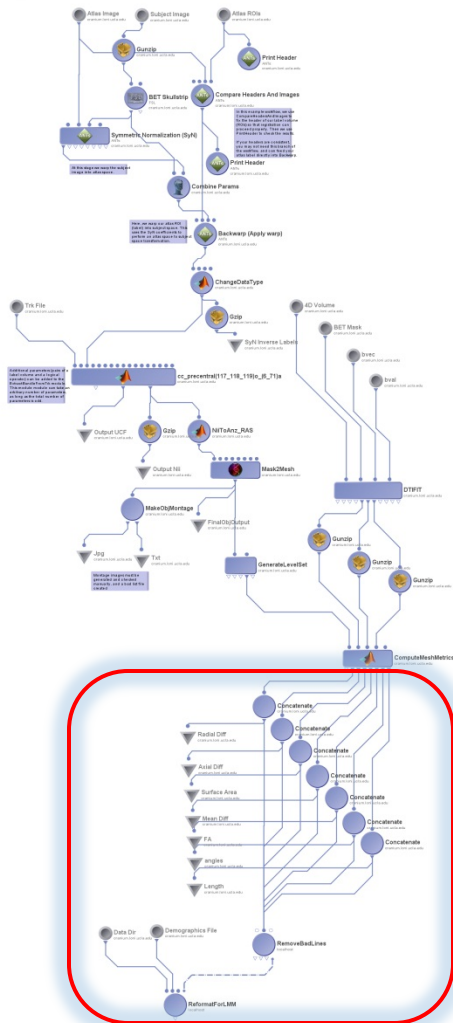


- Compute level contours
- Within each contour, sample values of FA, diffusivity, thickness, bending angle





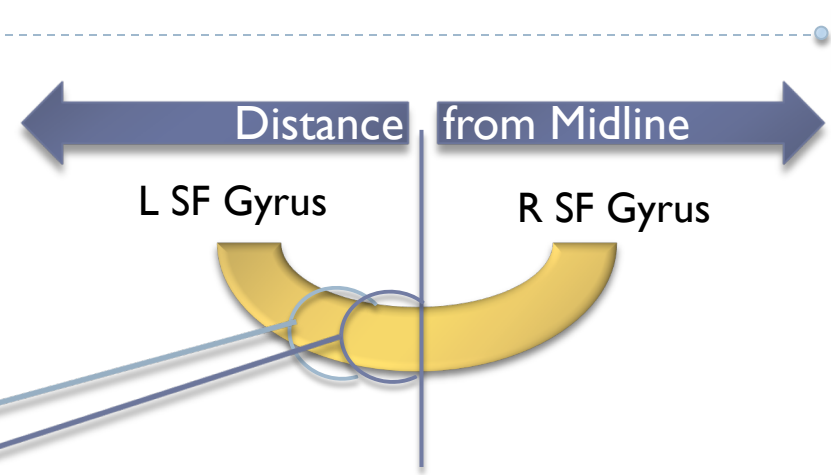
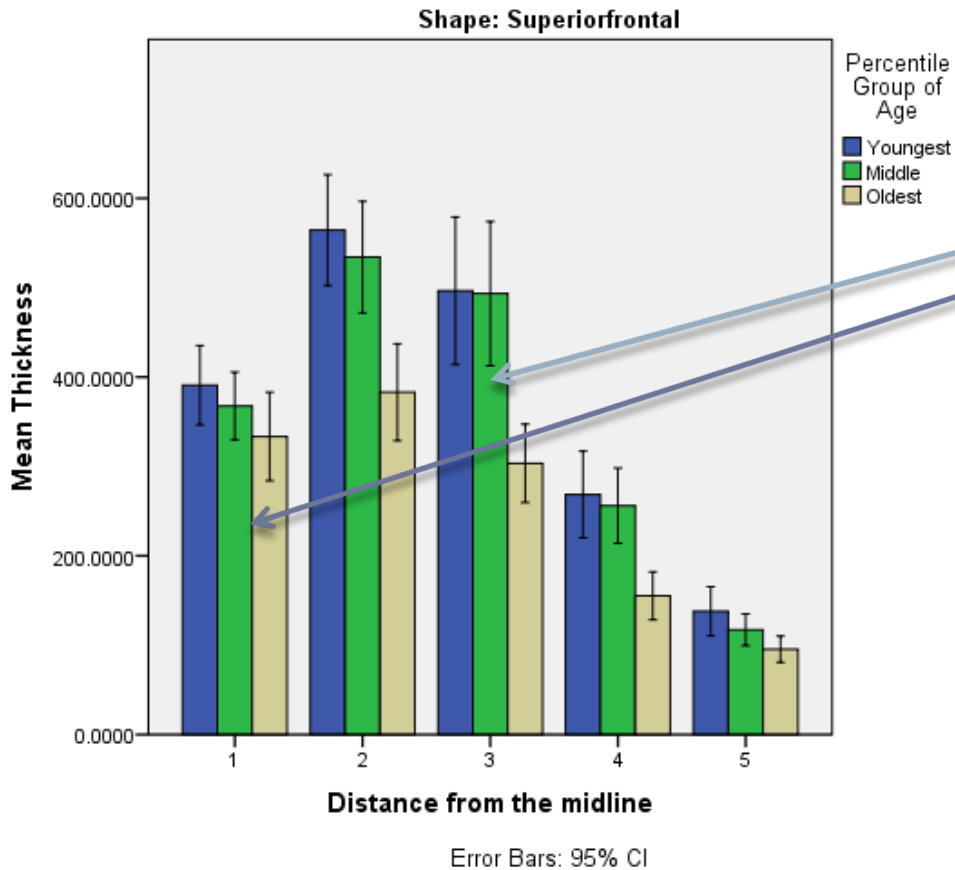
# Pipeline automation



- Starting point: DICOM
- Tractography
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- Surface measurement
- **Output to SPSS**

	MEASURE1	MEASURE1 (MM)	MEASURE2	MEASURE2 (MM)
1	.00102791	1.028	.00068979	.690
2	.00083577	.836	.00055371	.554
3	.00079441	.794	.00054143	.541
4	.00070014	.700	.00051978	.520
5	.00070959	.710	.00055224	.552
6	.00063927	.639	.00044066	.441
7	.00069691	.697	.00049987	.500
8	.00072059	.721	.00055420	.554
9	.00076178	.762	.00056767	.568
10	.00091364	.914	.00082441	.824
11	.00073849	.738	.00042323	.423
12	.00111424	1.114	.00081860	.819
13	.00075225	.752	.00062545	.625
14	.00062953	.630	.00036144	.361
15	.00063940	.639	.00043727	.437
16	.00065992	.660	.00049483	.495
17	.00067116	.671	.00050435	.504
18	.00061821	.618	.00042617	.426
19	.00082916	.829	.00072941	.729
20	.00066272	.663	.00050036	.500
21	.00097407	.974	.00066021	.660
22	.00069242	.692	.00040176	.402
23	.00073333	.733	.00055953	.560
24	.00062597	.626	.00047928	.479
25	.00065615	.656	.00045731	.457
26	.00061656	.617	.00042116	.421
27	.00065237	.652	.00052642	.526
28	.00060652	.607	.00037258	.373
29	.00069932	.699	.00050213	.502
30	.00080956	.810	.00067417	.674
31	.00074016	.740	.00042369	.424
	.00083279	.833	.00061337	.613
	.00068776	.688	.00052716	.527
	.00067506	.675	.00045296	.453

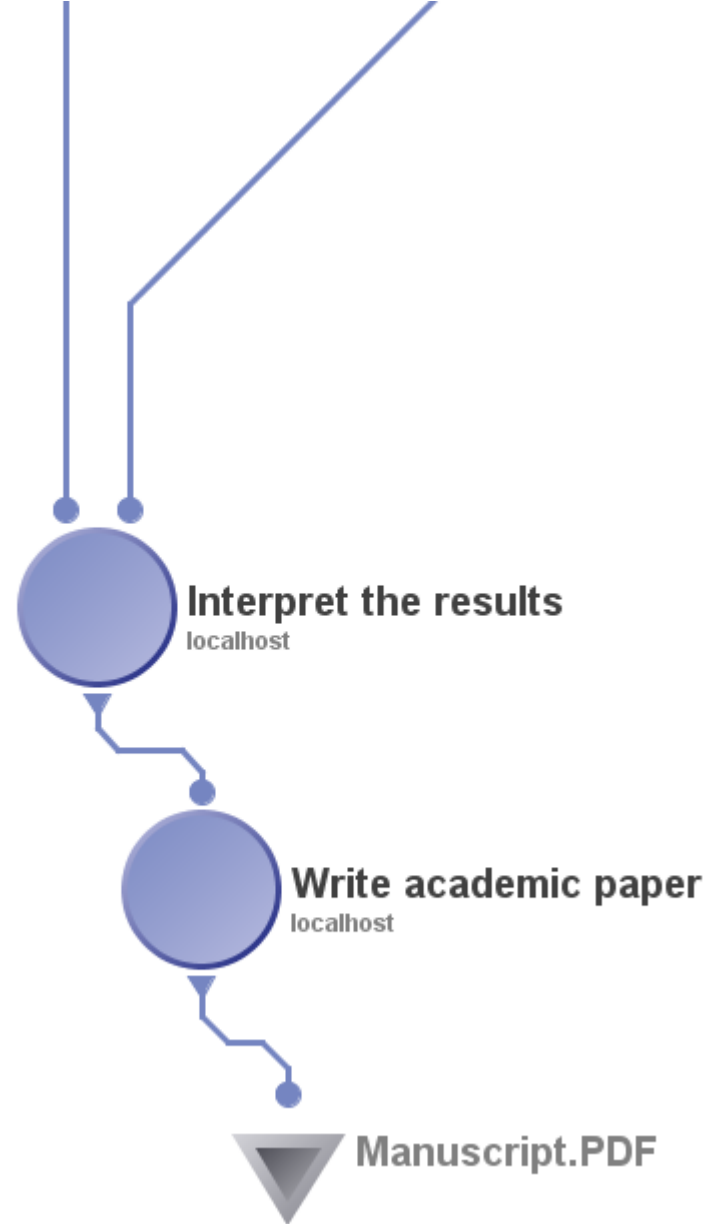
# Results



Linear mixed modeling:

- No interhemispheric differences
- Overall decreased thickness in oldest tertile (vs youngest,  $p < 0.001$ )
- Significant interaction between age and location across the bundle ( $p < 0.001$ )

# A pipe(line) dream



# Acknowledgements

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## ▶ Project

- ▶ Yonggang Shi, PhD
- ▶ Kristi Clark, PhD
- ▶ Arthur Toga, PhD

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- ▶ Jack Van Horn, PhD; David Shattuck, PhD; Ivo Dinov, PhD
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Questions?

# Media References

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- ▶ **Images**

- ▶ <http://www.ibiblio.org/rcip//images/corpuscallosum.jpg>

