# Down syndrome: Bridging Genes, Brain and Cognition

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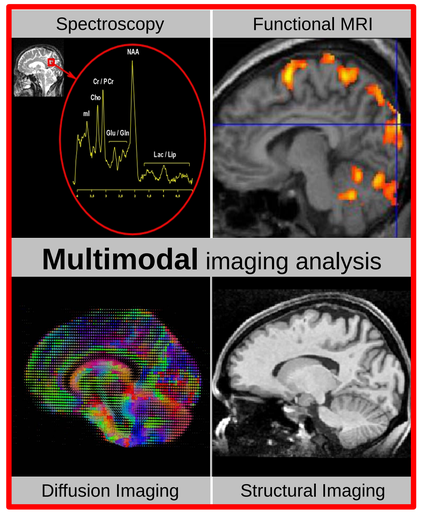
**Down Syndrome**
Occur in 1/800 births
> 300,000 in USA
> $2.1 B/year

Intellectual Disability
OCD
Heart Disease
Alzheimer's Disease
ADHD
Depression
Seizures
Leukemia

Treatment Targets
Drug Development
Translate to Medicine:
Diagnostics & Treatment
Brain Circuits
Diagnostics




Integration of Neuroscience and Genetics

Neuroimage Analysis

MRI/DTI MRS

Neural Imaging Twins

DS Learning and Memory

Patient Recruitment

**NIH Grant $3 Millions, 2011-16**

**Down Syndrome: Bridging Genes, Brain, and Cognition**

Biomarkers for Translational Treatments of Intellectual Disabilities

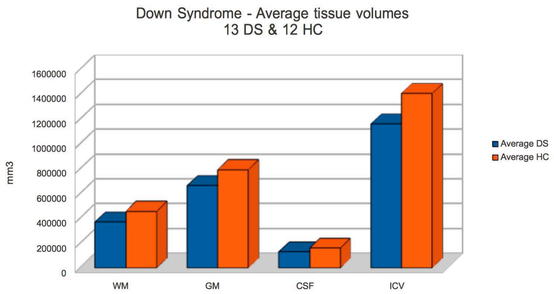
Generate Core Expertise

Utah Recognized Among Premier Centers for Neurodevelopmental Disorder Imaging & Treatment

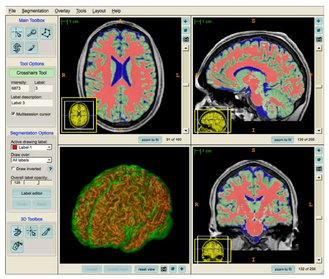
## Brain structural analysis

Typical Down Syndrome phenotype includes **different trajectories of neuroanatomy development**. Analysis of these differences will give insight into genotype, phenotype, behavioral relationships and influence of genetics on brain development.

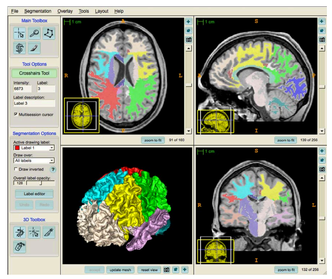
Analysis performed on 13 Down syndromes (DS) and 12 healthy subjects (HC):
=> Average lobar tissue volumes show significant group differences.
=> Average subcortical structures volumes show significant group differences.



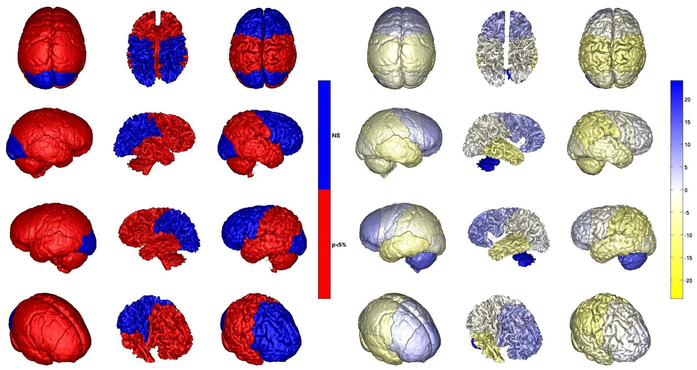

Average volumes of brain tissues, fluid and intra-cranial space for the 2 groups



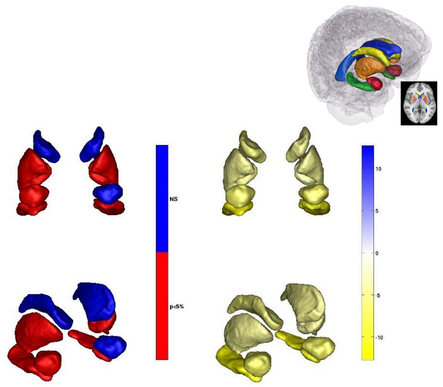
Tissue segmentation



Lobar white matter segmentation



Significance maps (LEFT) and ICV normalized lobar volume changes in percent between healthy controls (HC) and DS (RIGHT: blue: HC > DS, yellow: HC < DS)

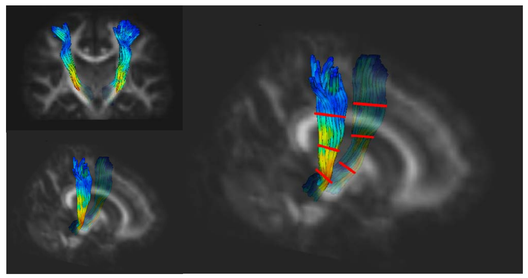


Significance maps (LEFT) and ICV normalized subcortical volume changes in percent between controls and DS (RIGHT: yellow: HC < DS)

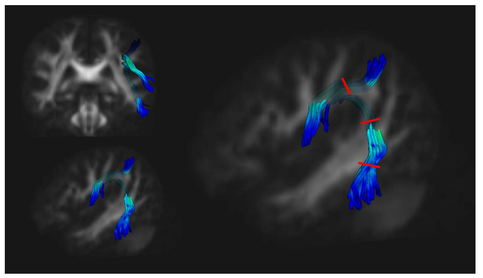
## White matter integrity analysis

Down syndrome subjects show **cognitive differences** that can be characterized in the white matter integrity of specific brain connectivity pathways. Brain white matter analysis can highlight relationship of genotype and brain connectivity analysis.
=> Most portions of analyzed tracts show highly significant group differences (lower fractional anisotropy in DS group).

**Motor tract:**
**associated with motor functions**



**Arcuate tract:**
**associated with language**



## Conclusion

Structural volumetric analysis demonstrates **significant differences of the trajectories** of brain anatomy development in DS subjects => Refined exploration of localized volume and shape differences will help define new biomarkers of disease.

White matter integrity analysis **reflects the observed cognitive differences** between Down syndrome and control groups => White matter tract analysis might serve as a biomarker of specific aspects of cognitive development.

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