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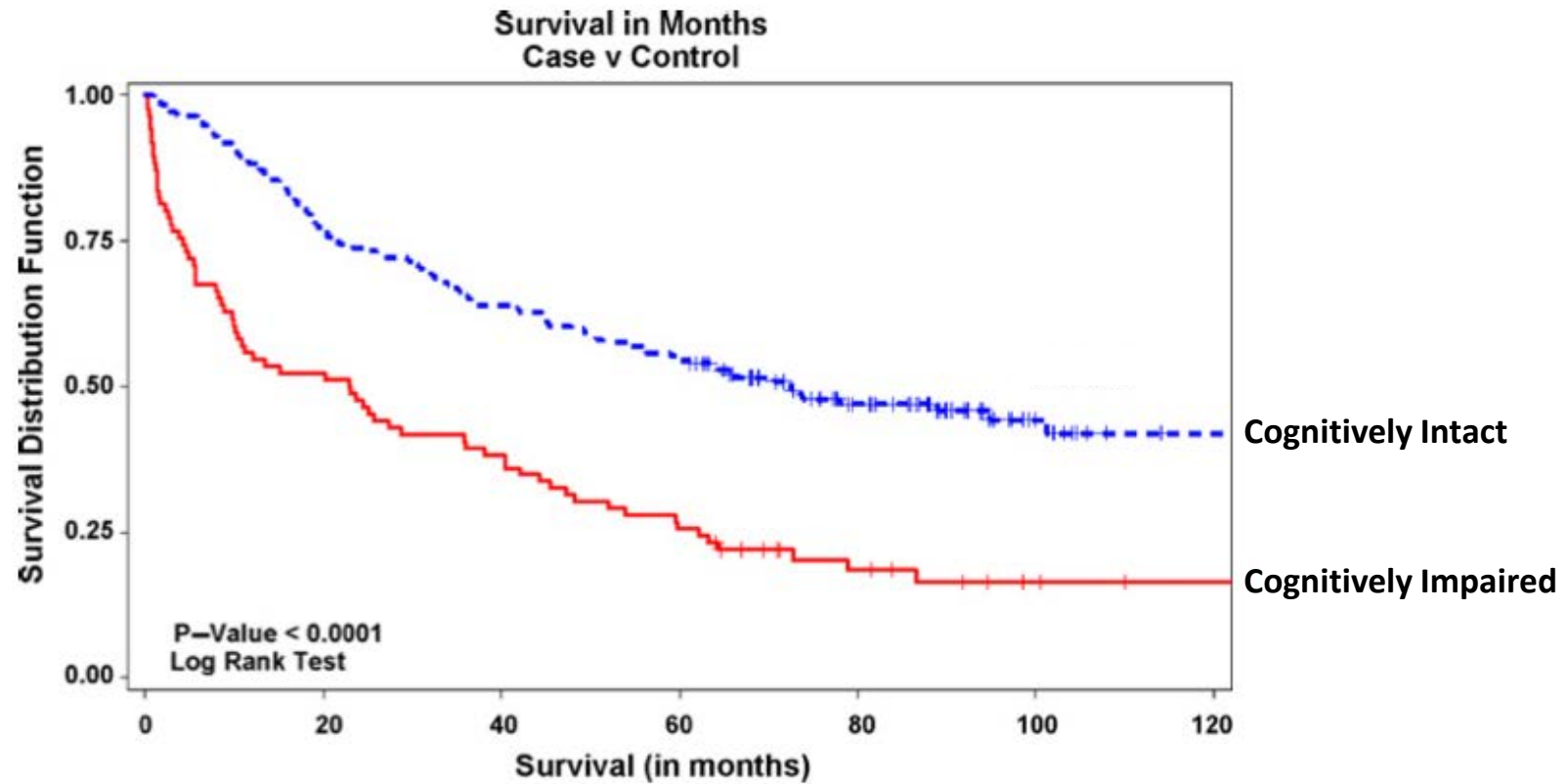
# Neurobiomarkers of Cognitive Dysfunction in Patients with Cancer

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SHELLI R. KESLER, PHD

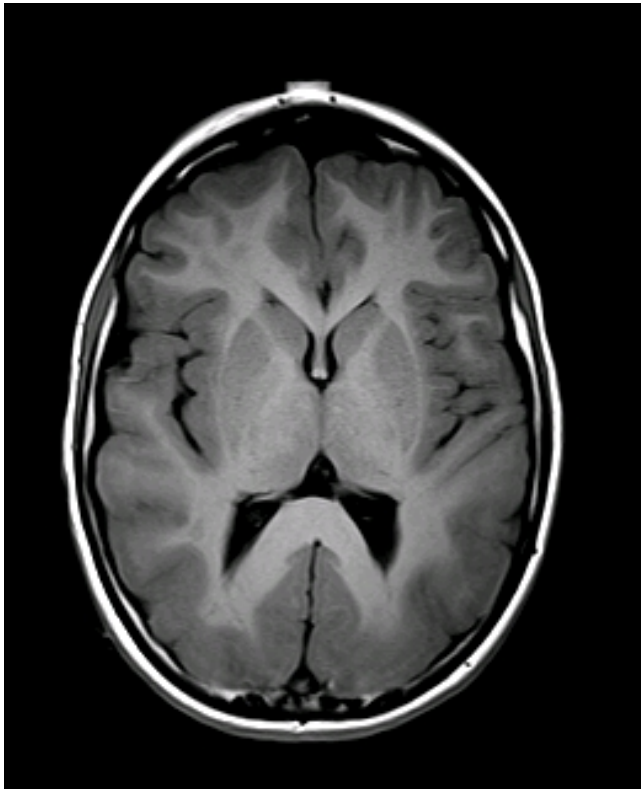
ASSOCIATE PROFESSOR OF NEURO-ONCOLOGY

# Impact of Cognitive Difficulties

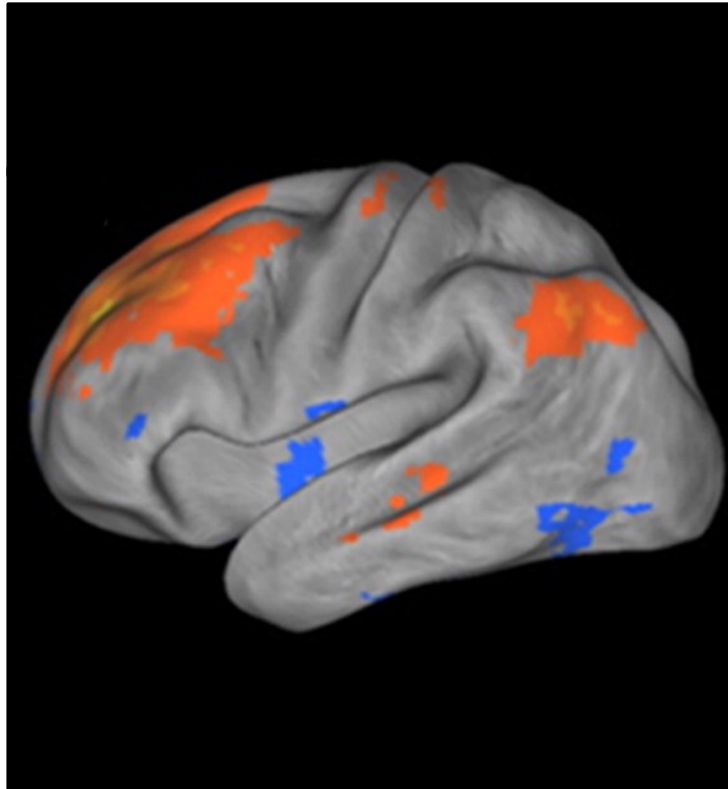


# Neuroimaging Biomarkers

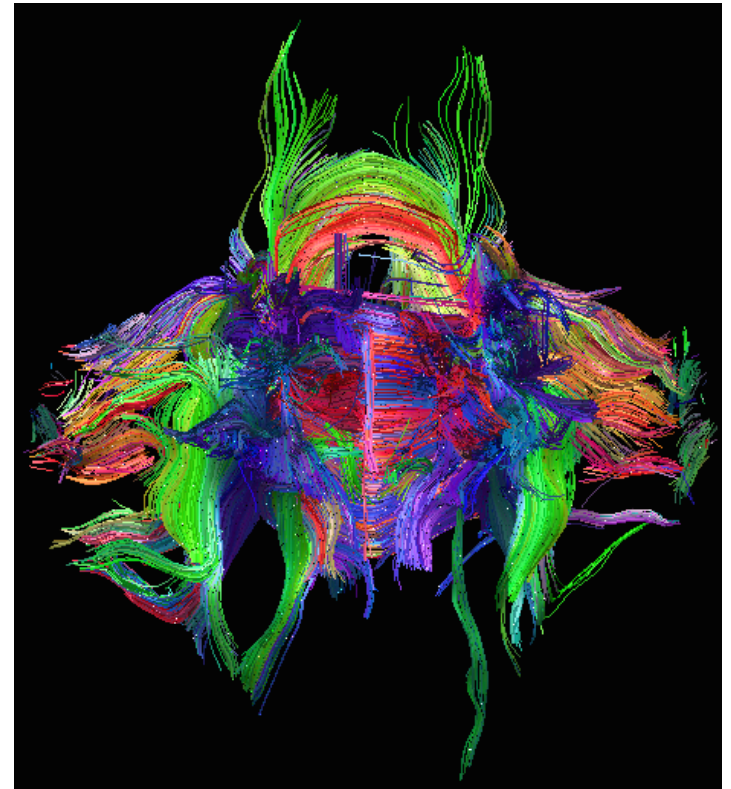
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T1-weighted MRI

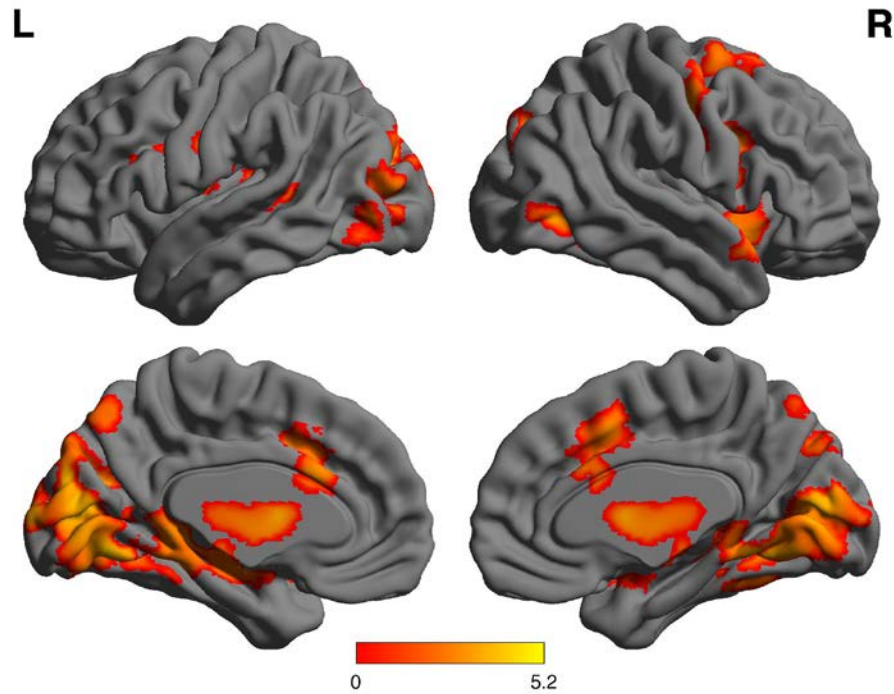


Functional MRI (fMRI)

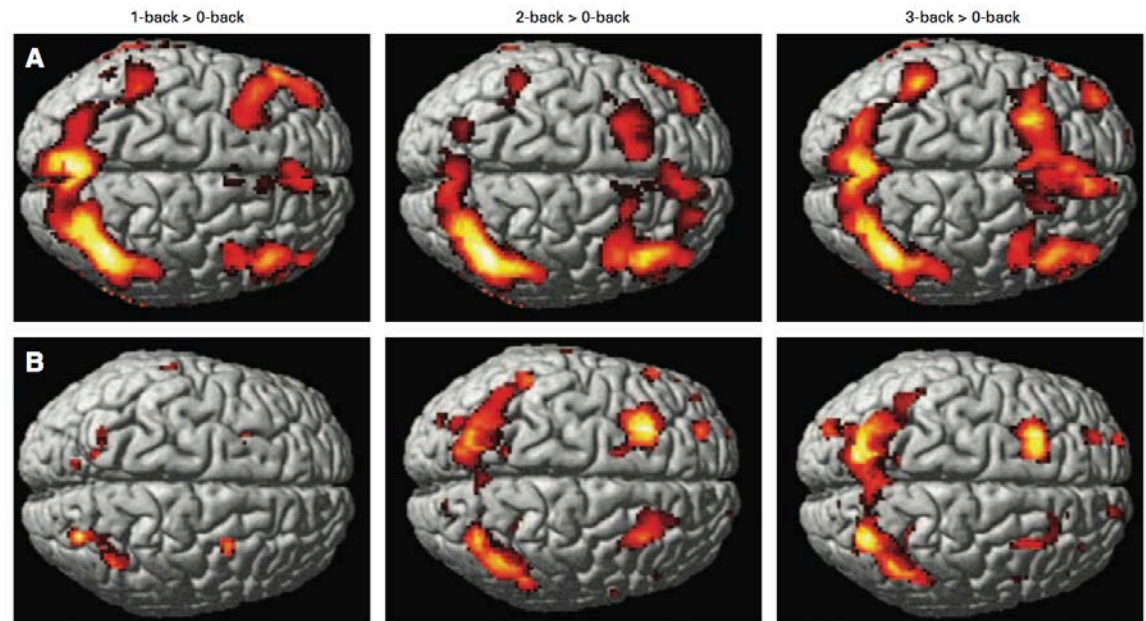


Diffusion Tensor Imaging (DTI)

# Hyperactivity

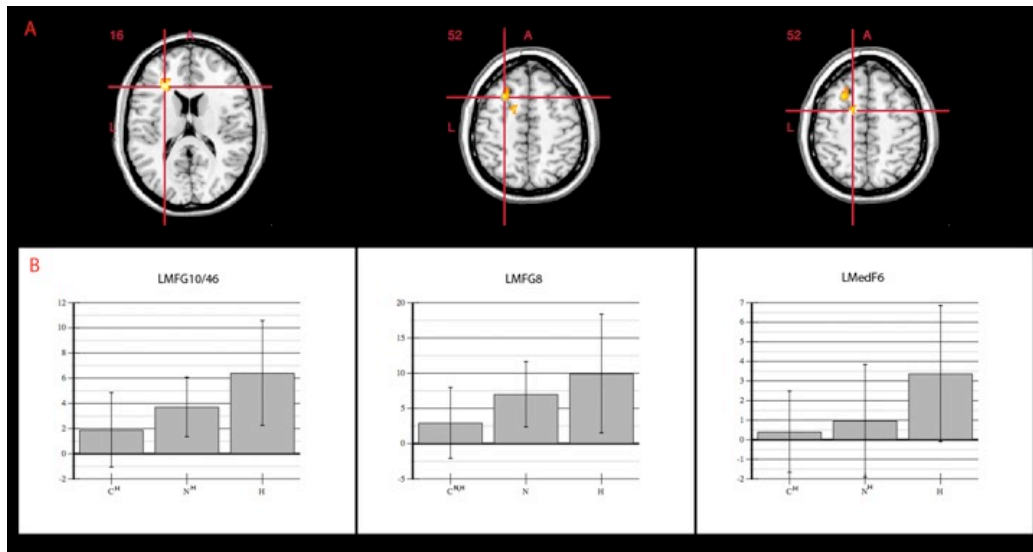


Kesler, SR, *et al.* 2009. Clin Cancer Res, 15, pp. 6665-73.

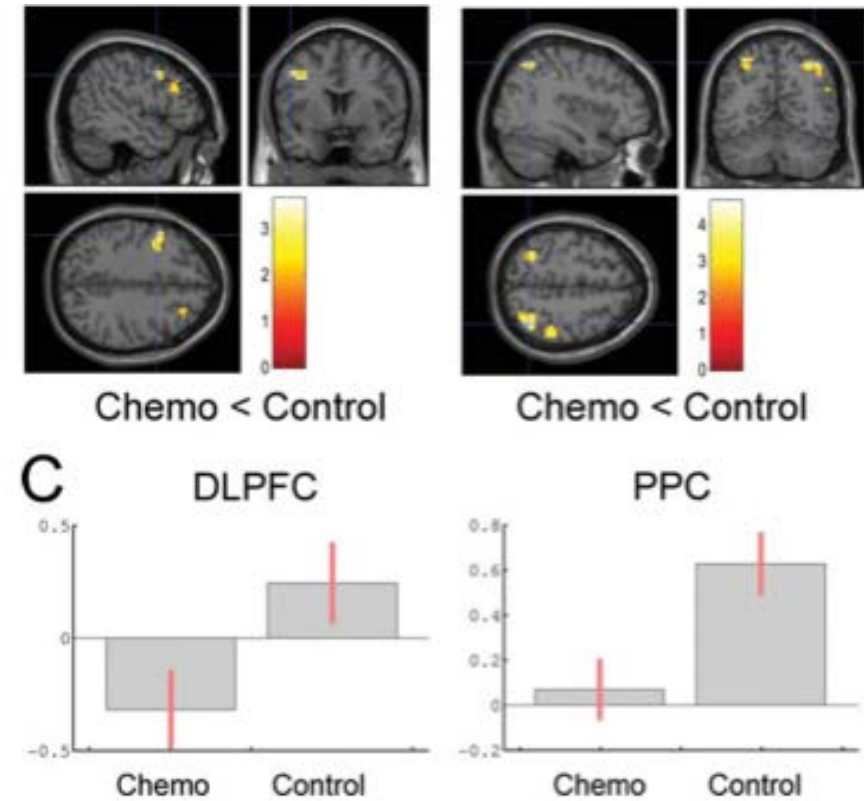


Ferguson, RJ, *et al.* 2007. J Clin Oncol, 25, pp. 3866-70.

# Hypoactivity



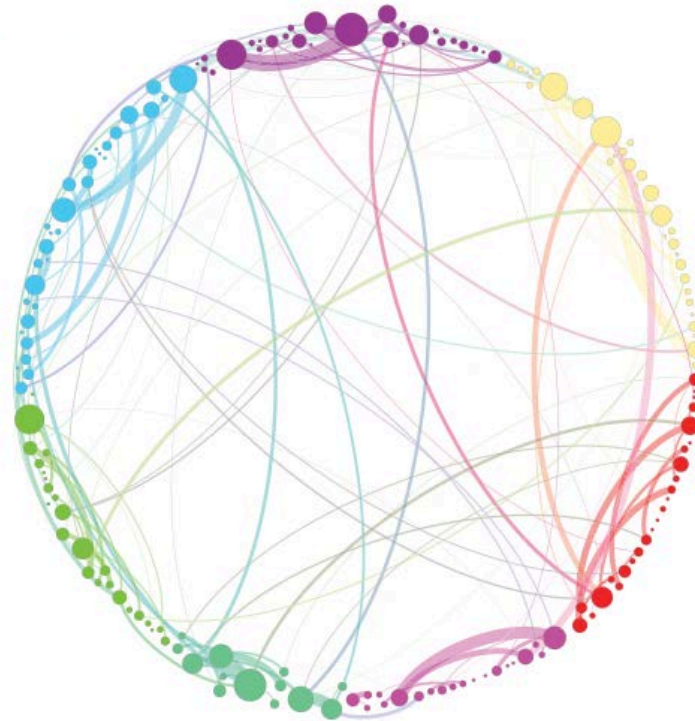
Kesler SR, Kent JS, O'Hara R. JAMA Neurology. 2011;68(11):1447-53.



de Ruiter, MB, et al. 2011. Hum Brain Mapp, 32, pp. 1206-19.

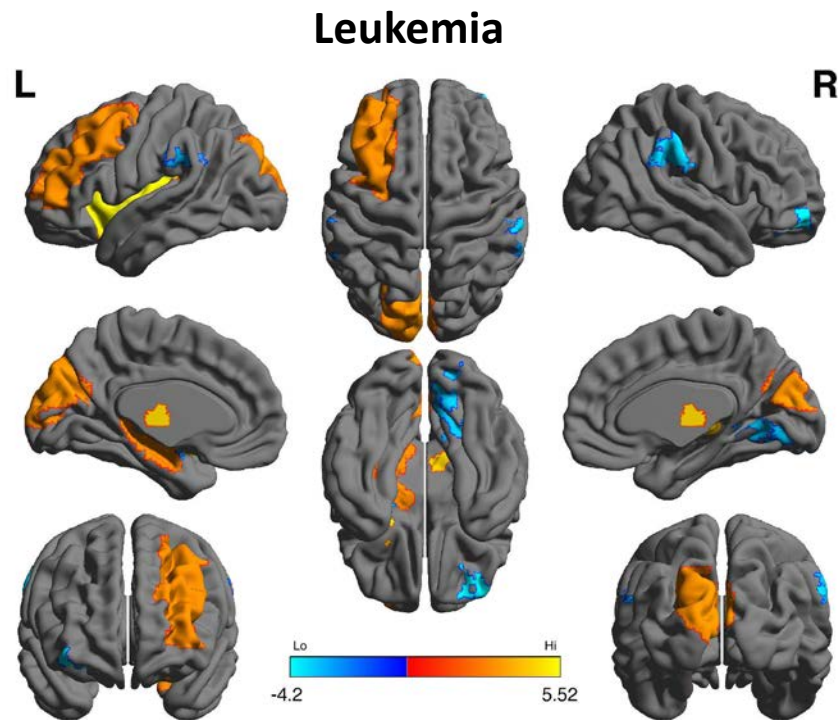
# Scale-free, Small-world Brains

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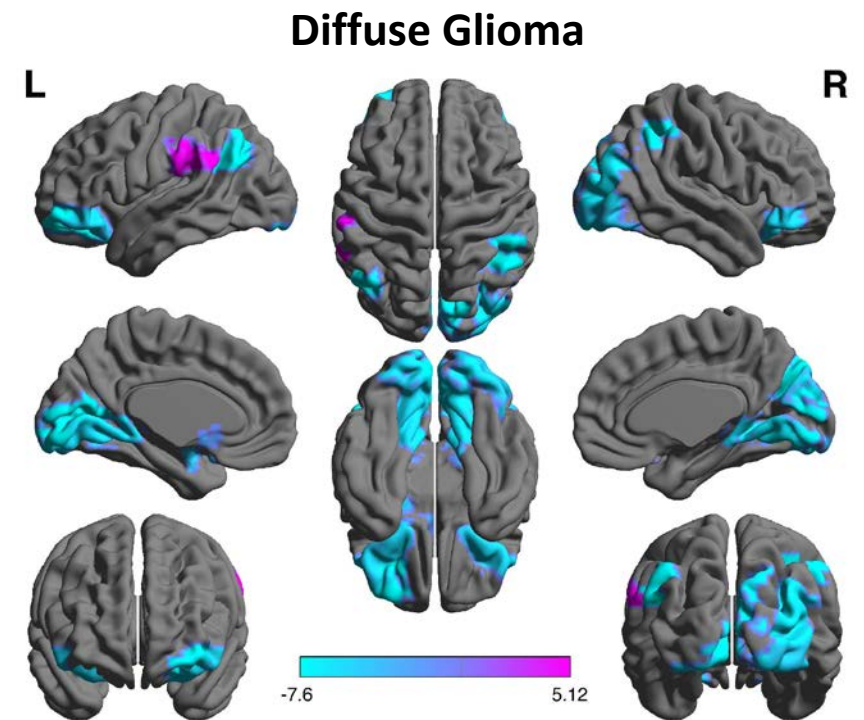




# Disrupted Small-World Organization



Kesler, SR, *et al.* 2016. *Brain connectivity*, 6, pp. 273-82.



Kesler, SR, *et al.* 2017. *J Neurooncol*, 131, pp. 565-574.

# Critical Brains

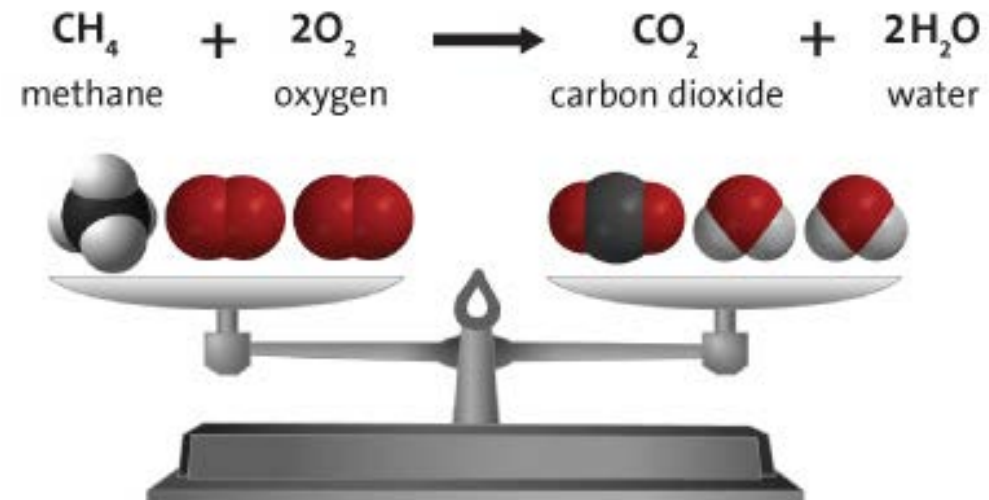
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Integration vs. Specialization

Random vs. Ordered

Efficiency vs. Metabolic Cost

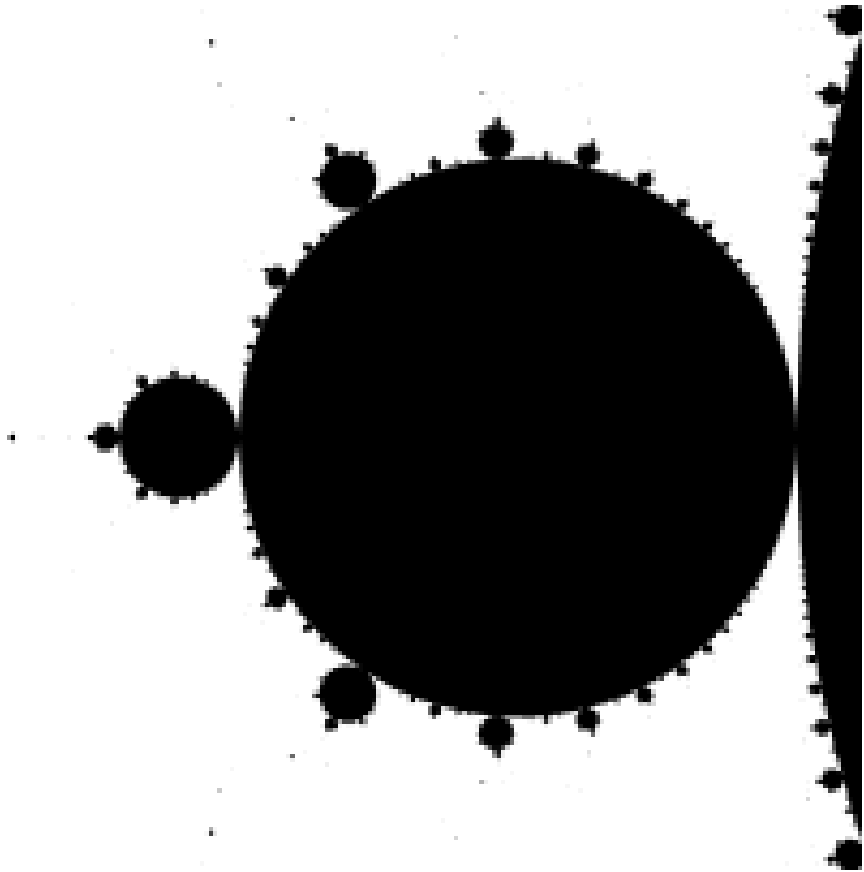
Stability vs. Flexibility





# Scale-Free Dynamics

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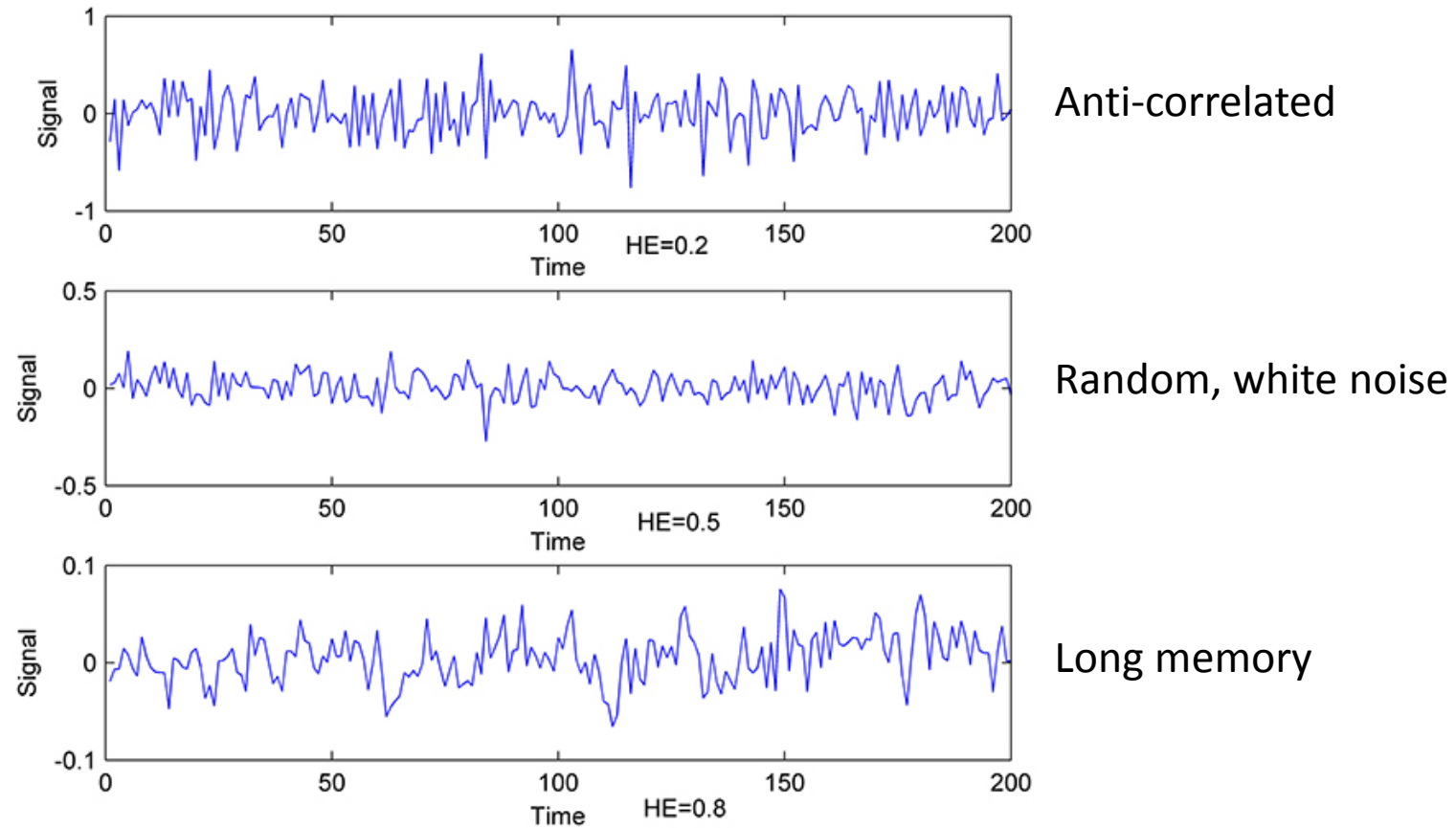


Fractal behavior in fMRI signals

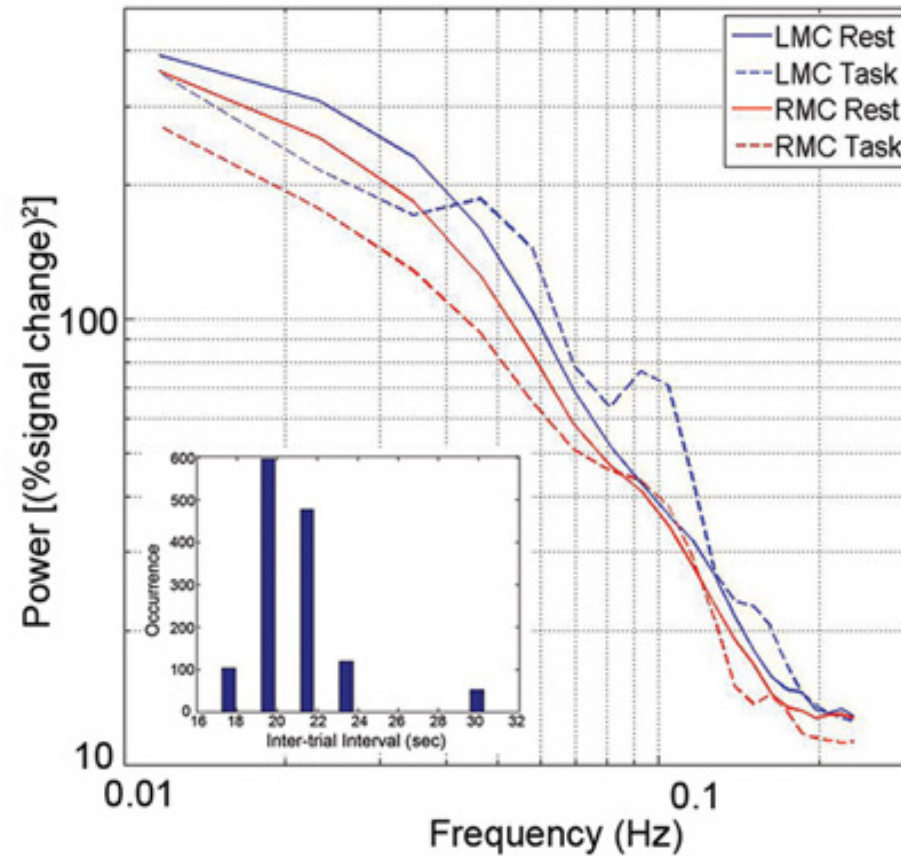
- Long-range dependence (“long memory”) and self-similarity in time

# Long Memory

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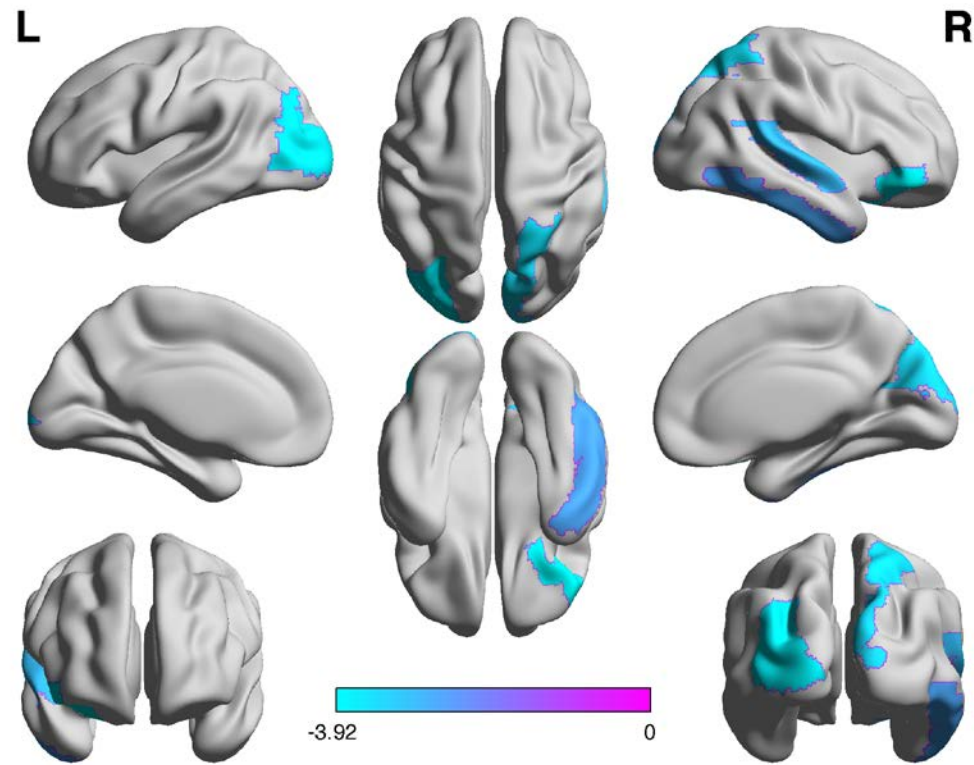


# 1/f Distribution

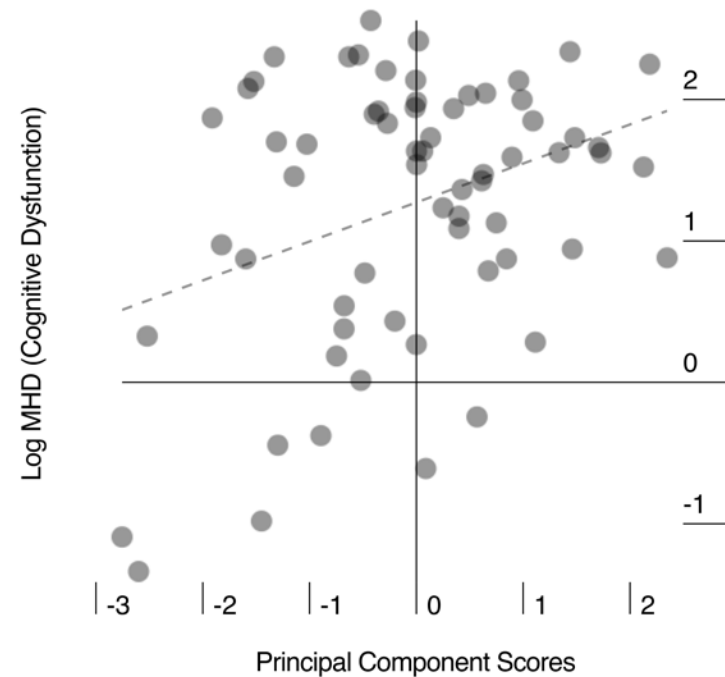
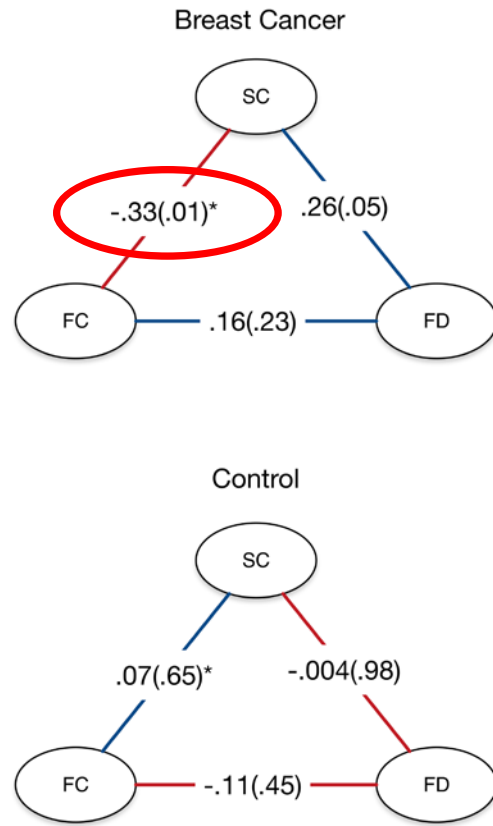


# Treatment Naïve Breast Cancer

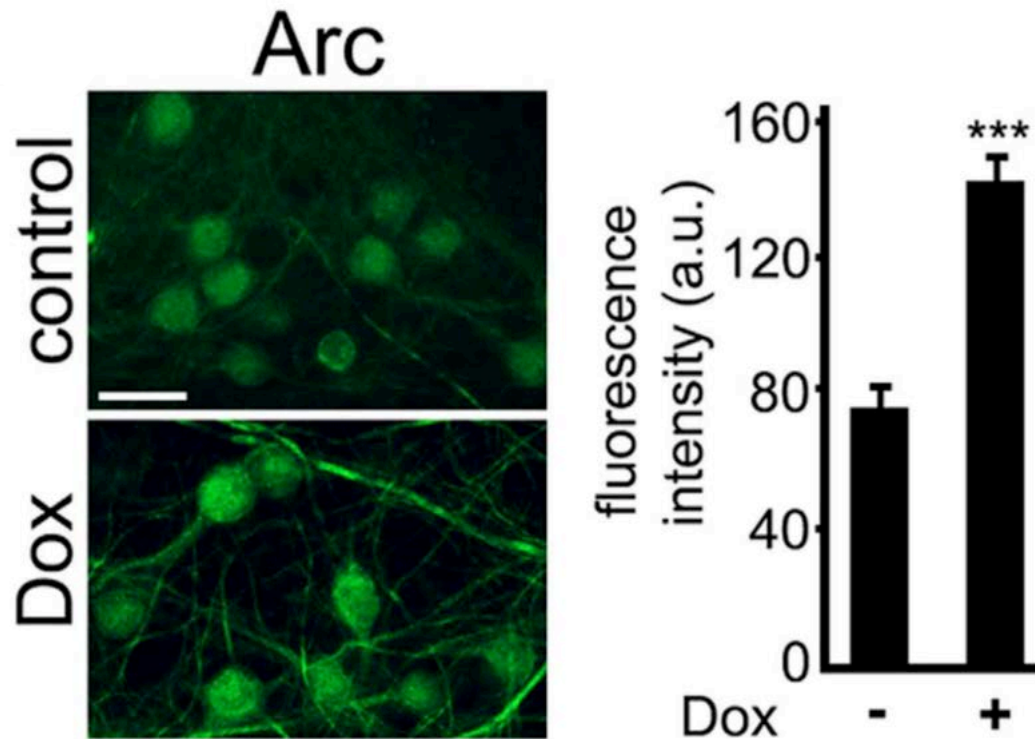
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# Topological/Dynamical Imbalance



# Excitotoxic Neural Activity?



Breast and other tumors initiate neurogenesis and release nerve growth hormone

Tumor aggressiveness associated with tumor-related neurogenesis

Aberrant CNS activity via peripheral innervation?



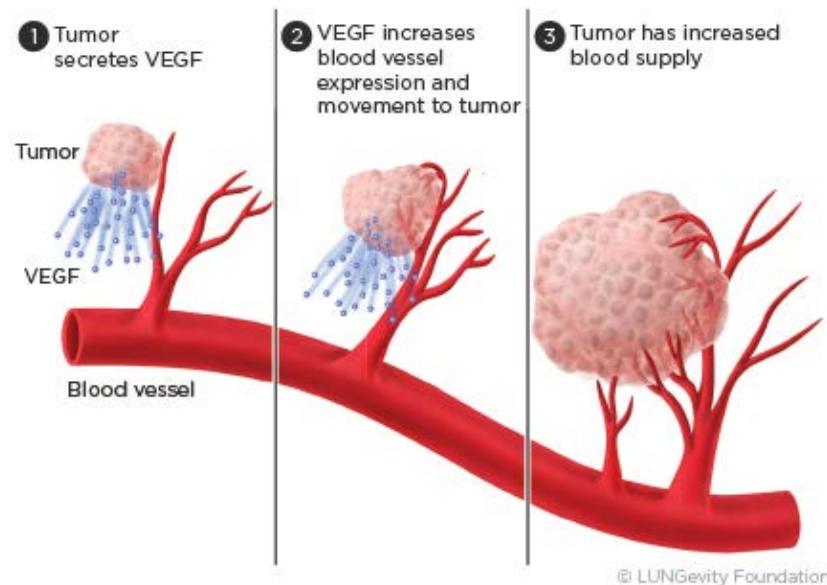
# Vascular Effects?

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Malignant tumors and inflammatory responses associated with angiogenesis

VEGF elevated following chemotherapy (Ng et al. 2013)

Increased incidence of cerebral small vessel disease (Koppelmans et al. 2015)



# Funders and Collaborators

THE UNIVERSITY OF TEXAS  
MD Anderson ~~Cancer~~ Center®

