NeuroImaging

James Ellis

Functional **MRI**
(**fMRI**)

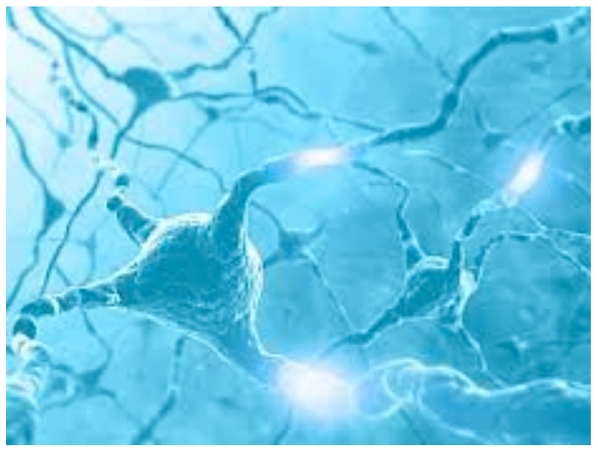
relies on what we call a **B**lood **O**xygenation **L**evel-**D**ependent signal

B O L D signal

BOLD signal

James Ellis

When neurons fire...



they expend energy,

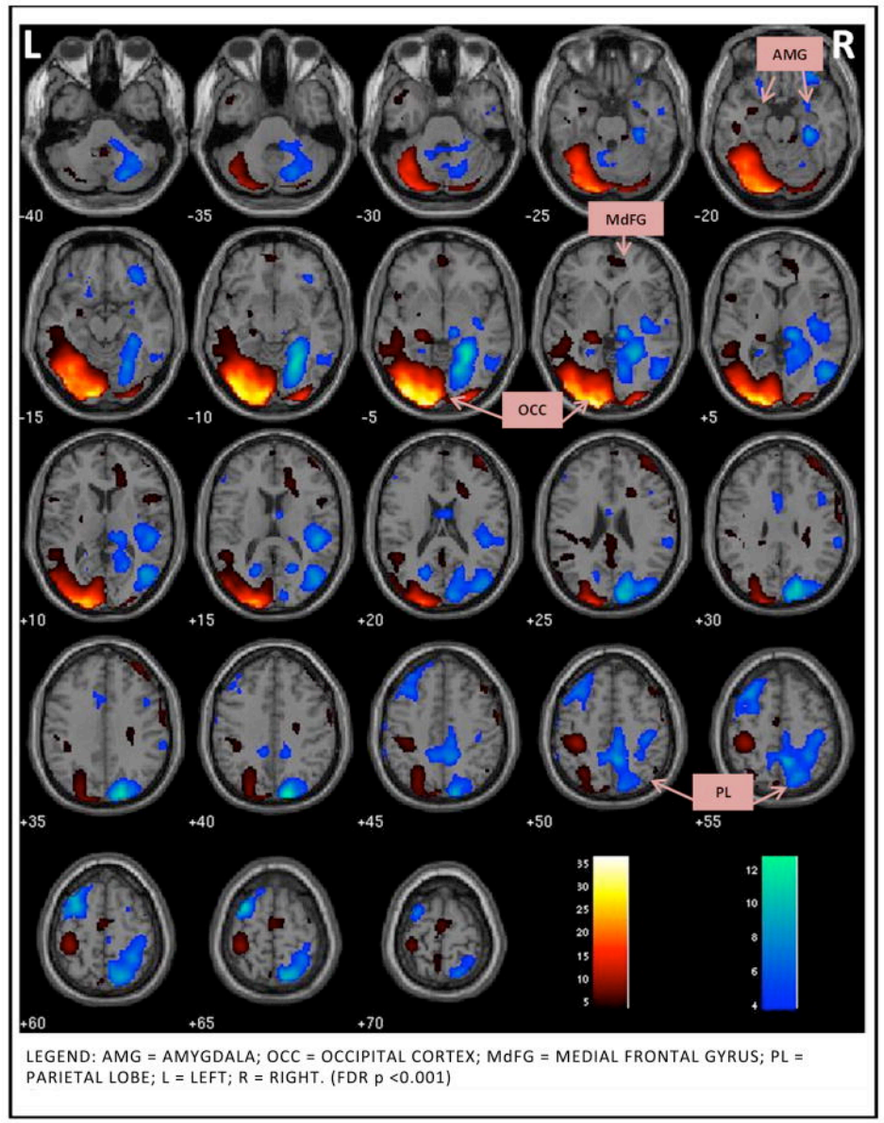
expel important chemical signalers,

...and need to be replenished!

BOLD signal

Influx of oxygenated blood **over-estimates** demand

Comparably high concentration of hydrogen molecules in this oxygenated blood is imaged by magnetic pulses



LEGEND: AMG = AMYGDALA; OCC = OCCIPITAL CORTEX; MdFG = MEDIAL FRONTAL GYRUS; PL = PARIETAL LOBE; L = LEFT; R = RIGHT. (FDR p <0.001)

Massive dimesionality

Early attempts at fMRI research used whole brain correlation of the time signals in every voxel (3mm cubes)

-- required huge Bonferroni corrections

Next came ROI, region of interest, analysis

-- constrains search space and lowers correction for false positives

Difficult even with typical, adult populations but working with children is even more difficult

ICA mitigates imaging problems

Spatial normalization in a widely ranging adolescent population leads to blurring

-- increases need for strong SNR

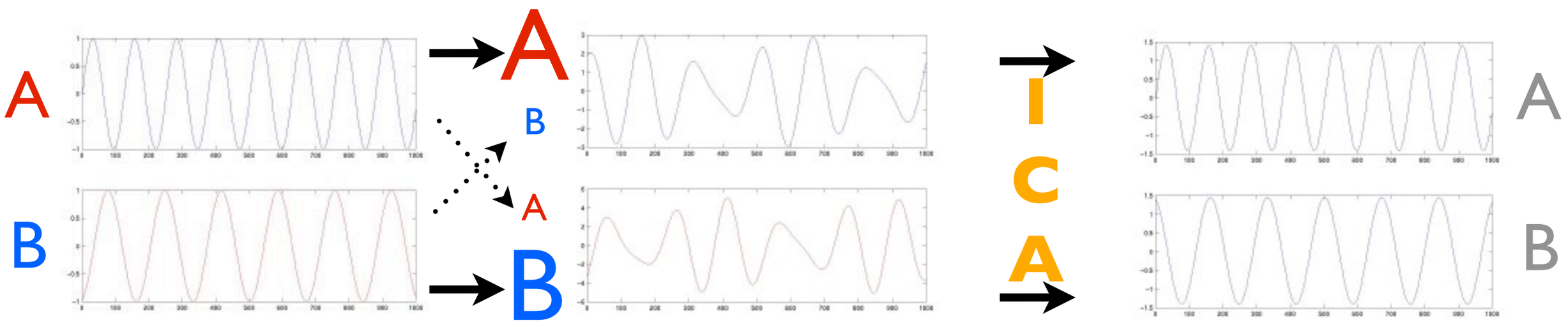
ICA isolates noise from signal as separate components

ICA in a

What is ICA?

Form of blind source separation

A technique to separate **linearly mixed** signals



ICA in a 

Step 1

Center the data

Step 2

Dimensionality reduction

Estimate number of independent components

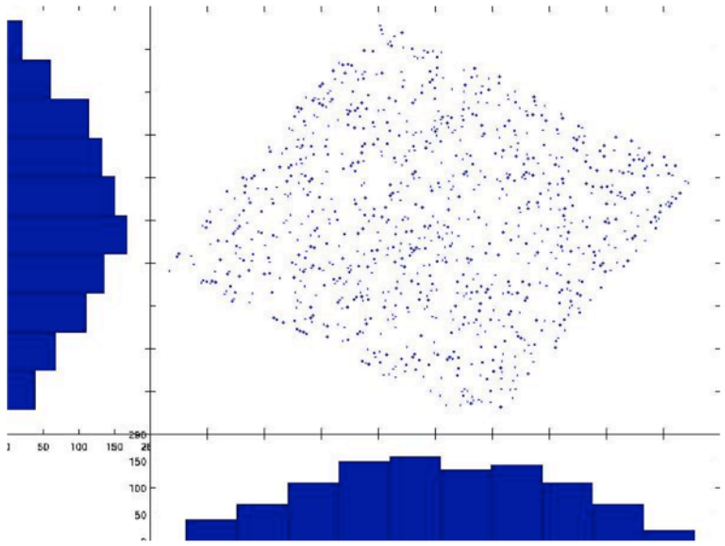
Step 3

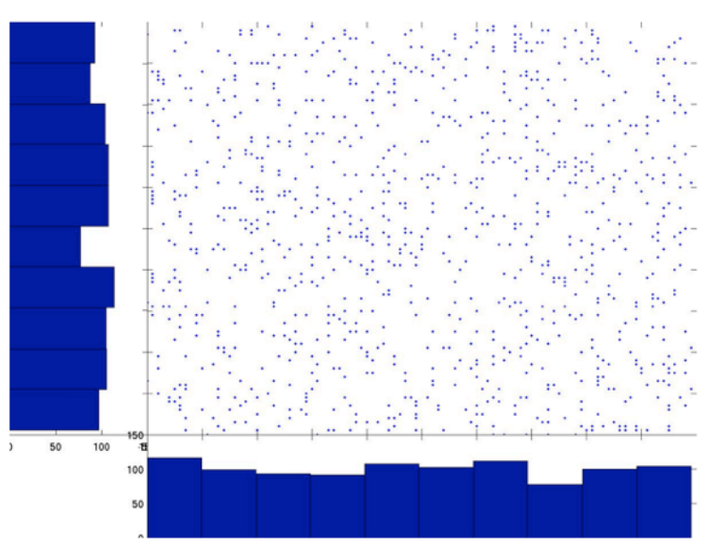
Whiten the data

ICA in a

Step 4

Rotate to remove Gaussianity





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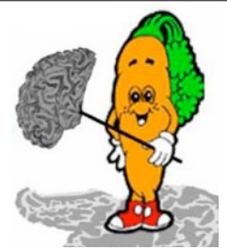

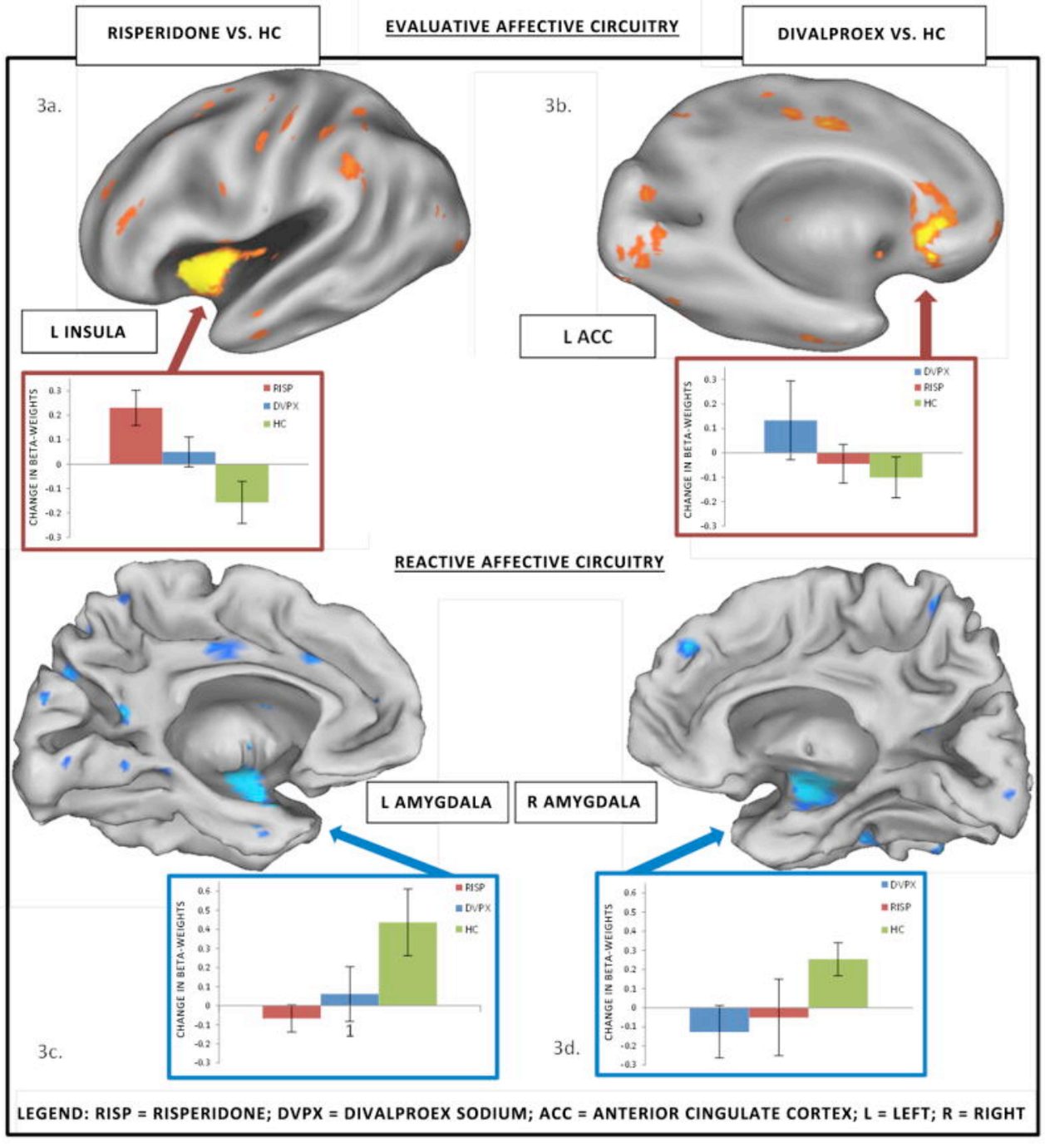

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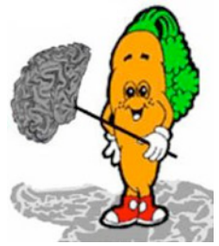

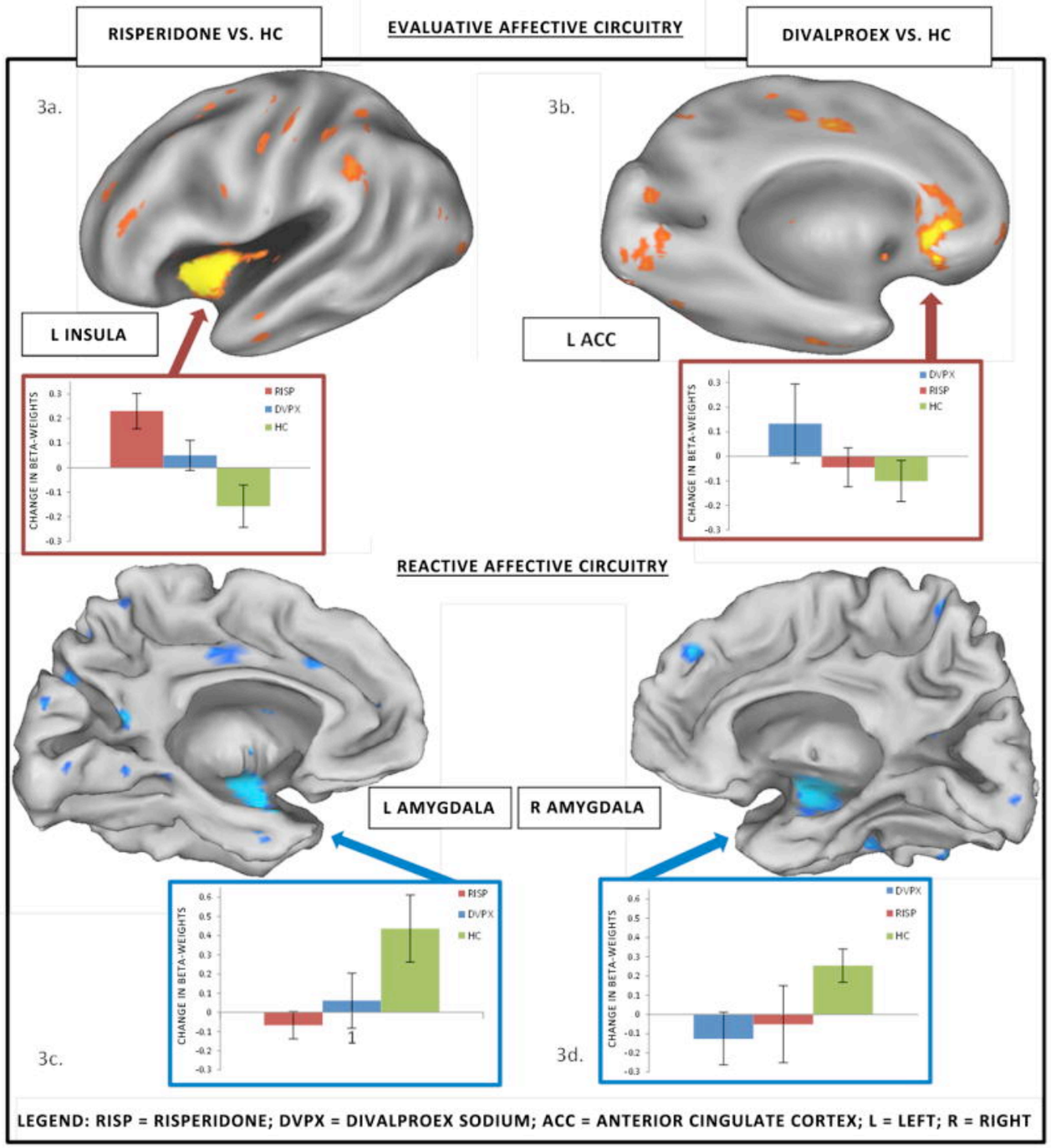

ICA produced two interacting brain networks

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