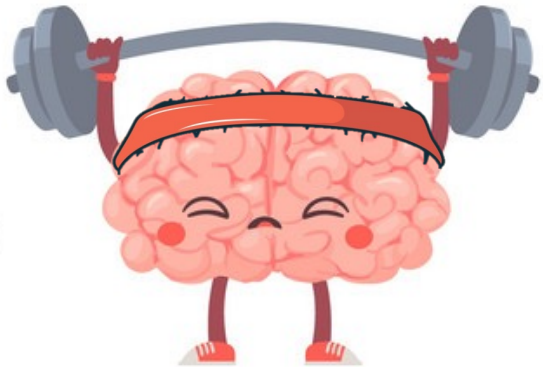
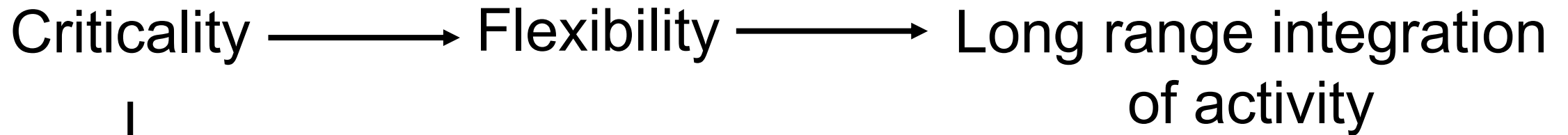
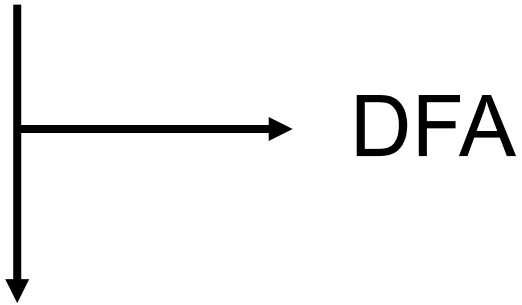


LET'S GET

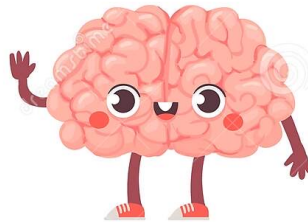
CRITICAL



Long Range Temporal Correlations

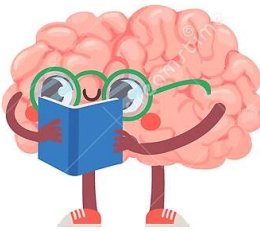


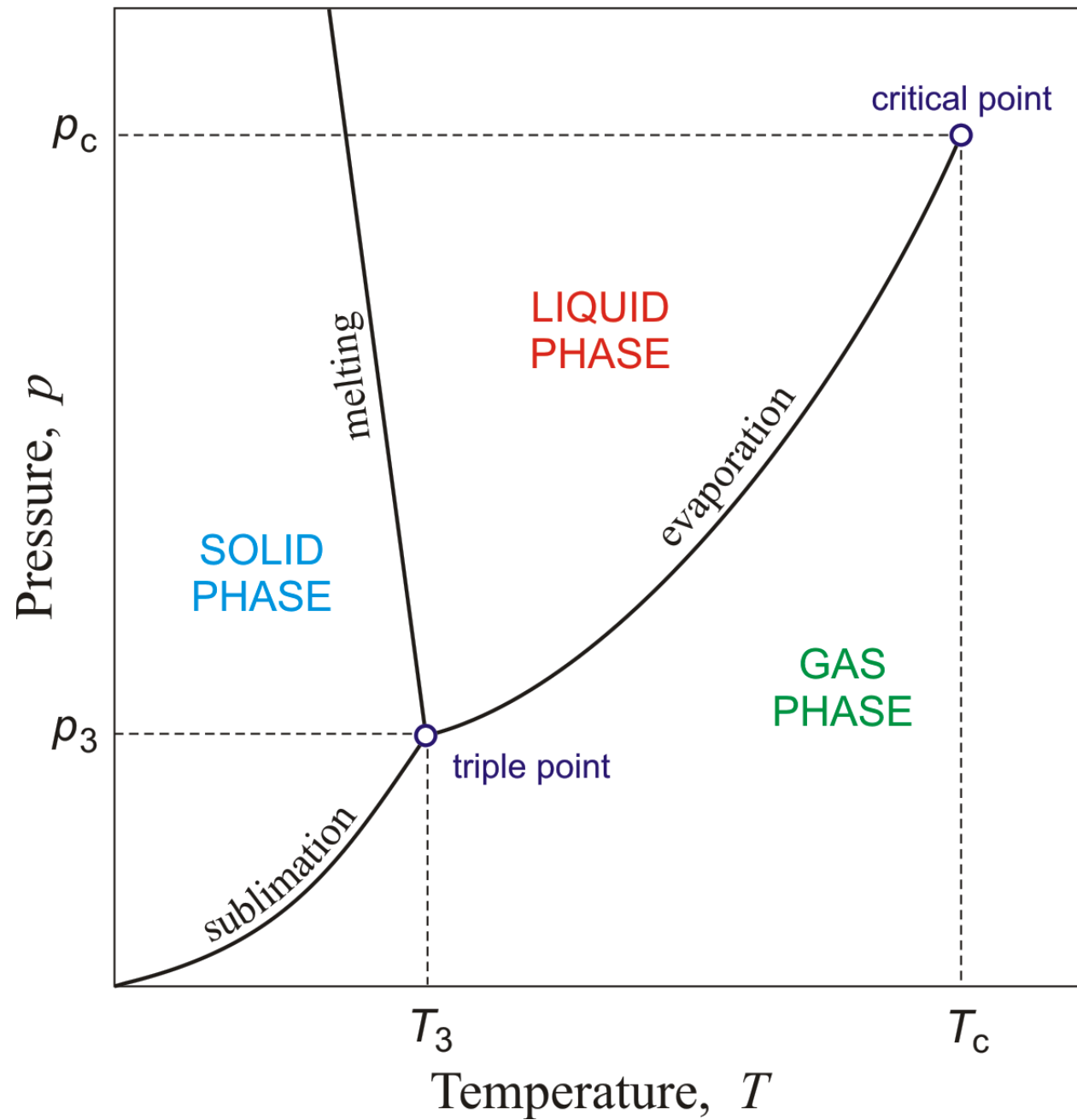
Eyes closed resting state activity exhibits characteristics of a more “critical” state as you age



What is Brain Criticality?

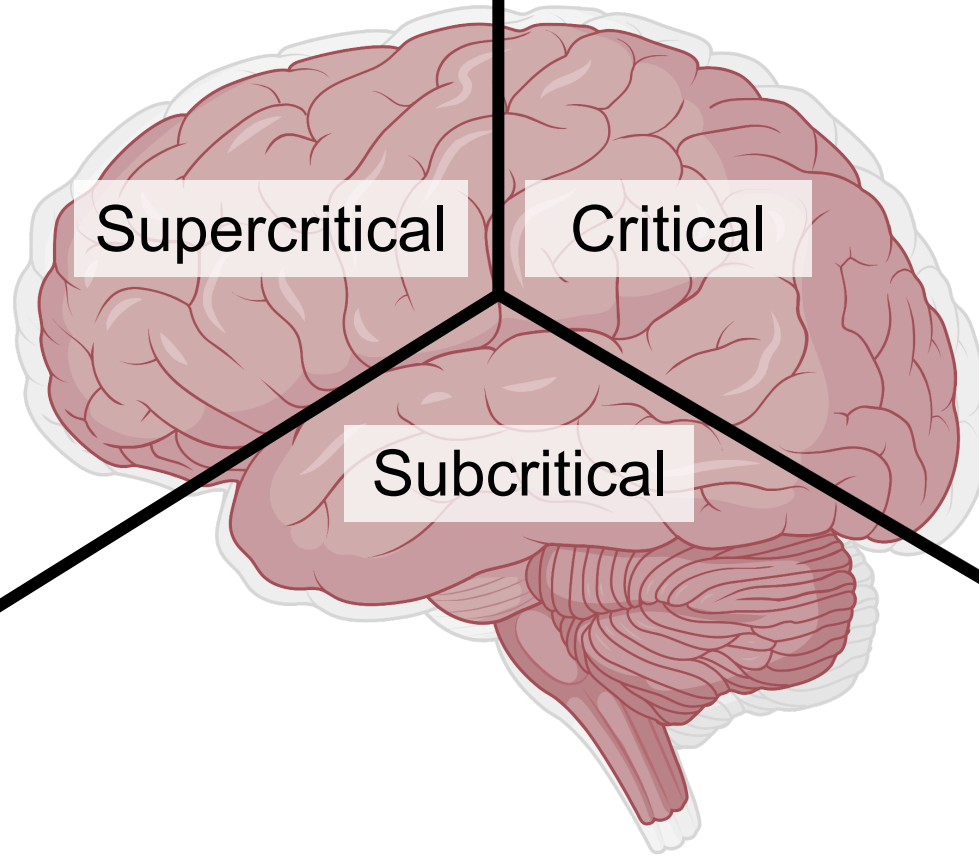
- Marks the transition between ordered and disordered states
- At criticality: Optimal processing, information storage, computational power, etc.
- Optimizes coupling between neuronal networks
- Optimal state is neither fully synchronized nor fully segregated
 - Transient changes in phase and amplitude allow flexibility





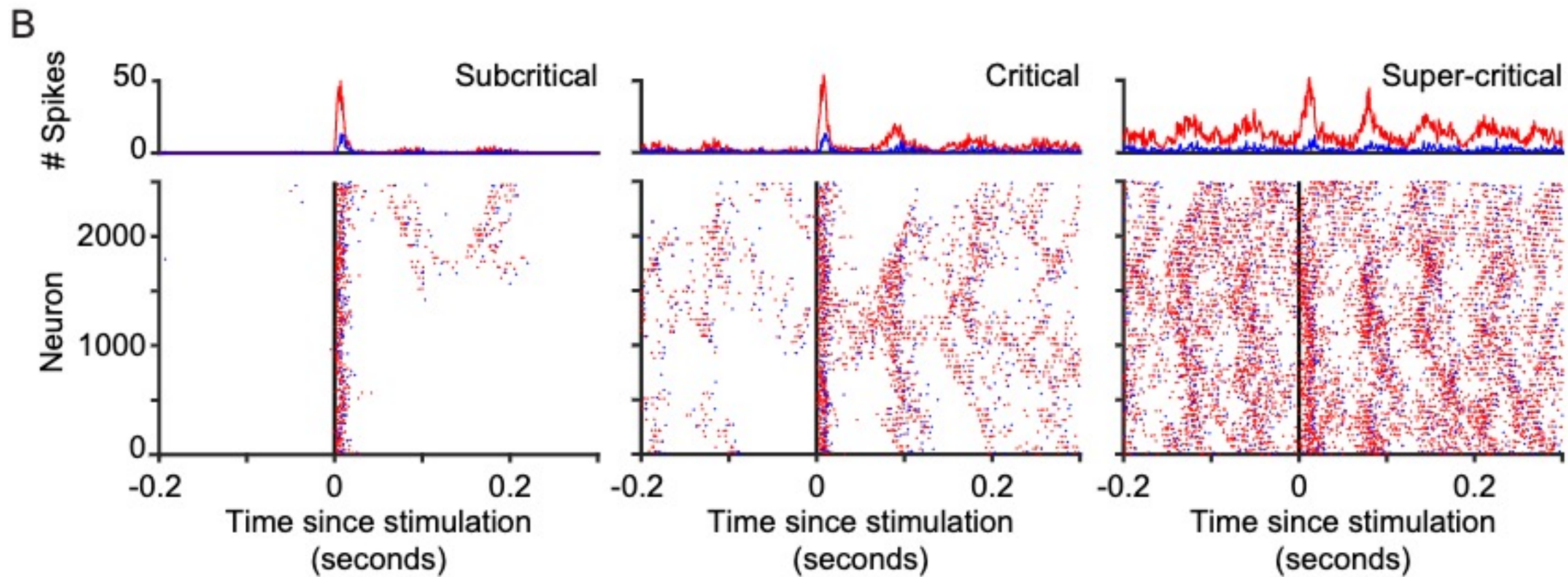
- Excessive net excitation
- Branching parameter greater than 1
 - Neurons activate
 $2 \rightarrow 4 \rightarrow 16$

- Neuronal networks exhibit scale-free spatial and long-range temporal correlations of activity



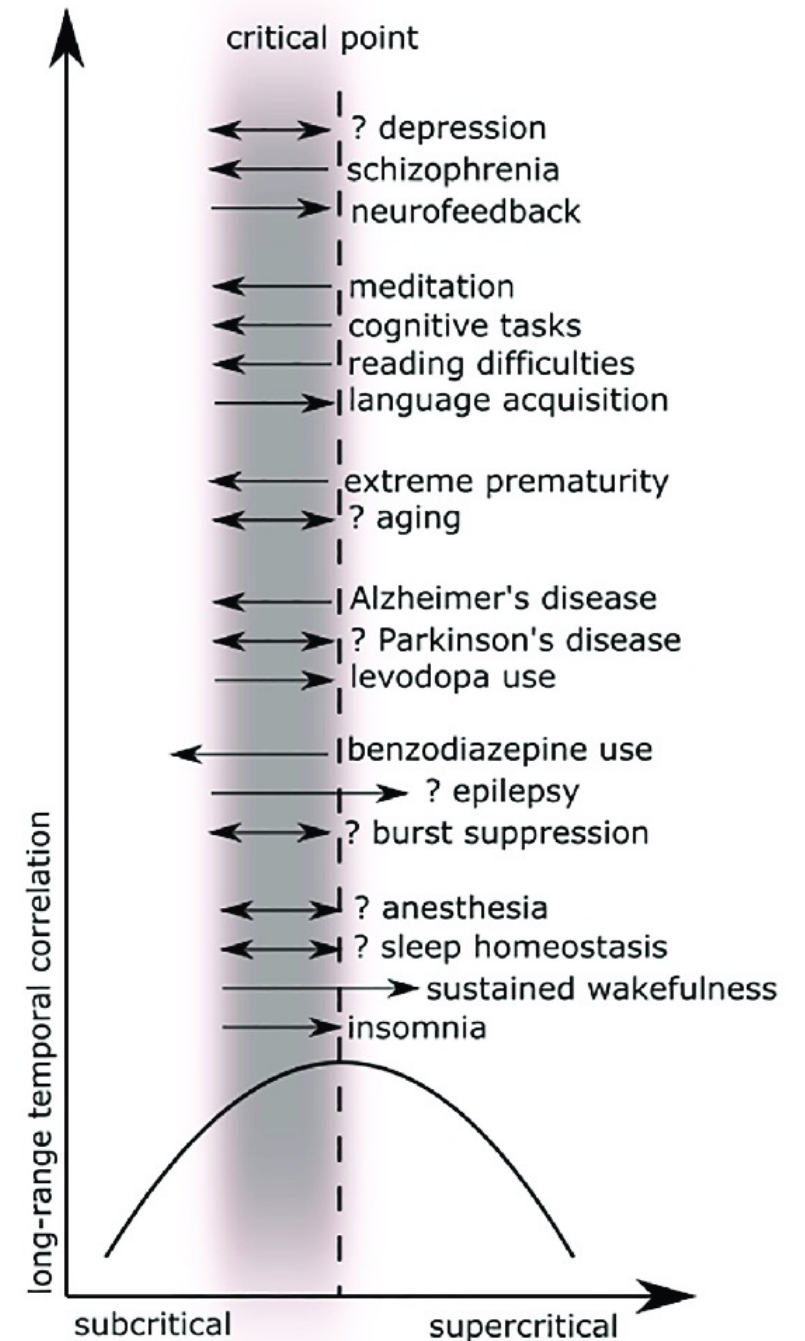
- Phase and amplitude coupling of oscillations
- Response to external stimuli is maximized
- Increase in perceptual switching

- Excessive net inhibition
- Branching parameter less than 1

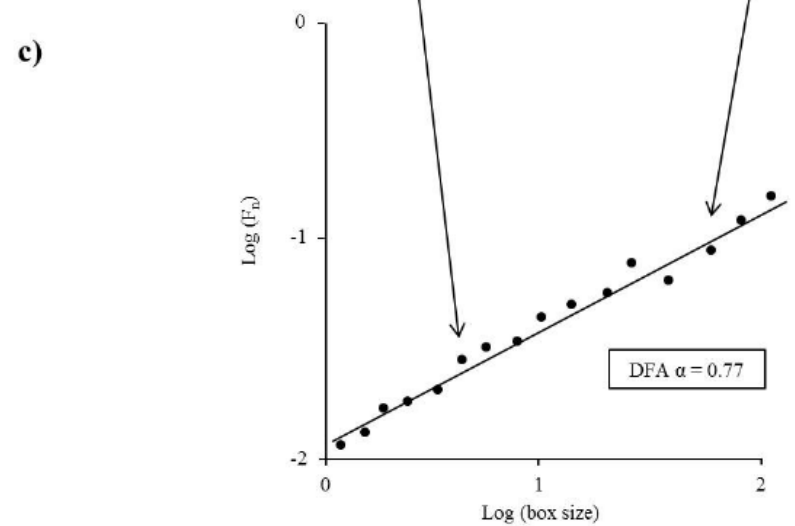
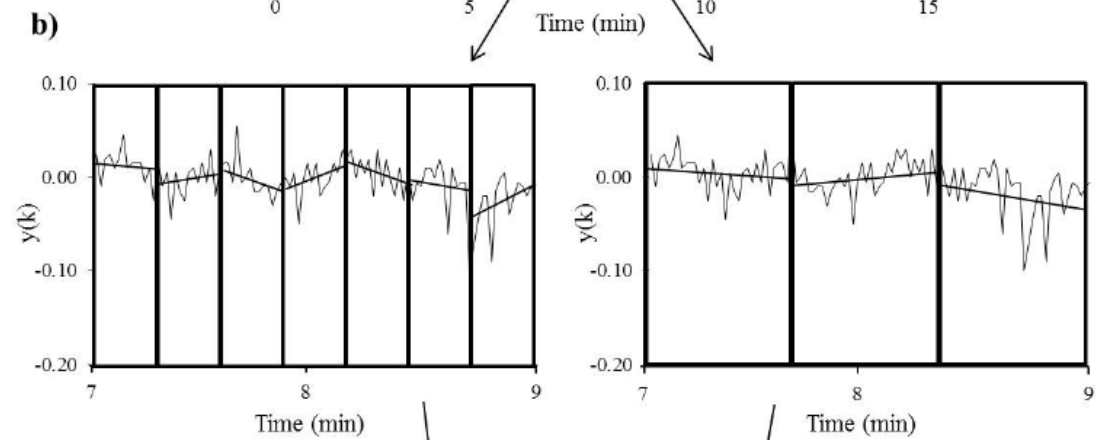
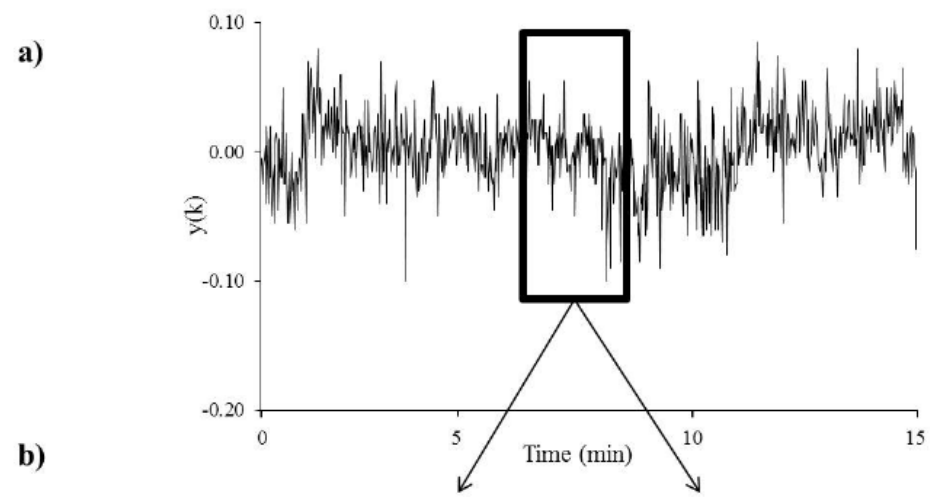


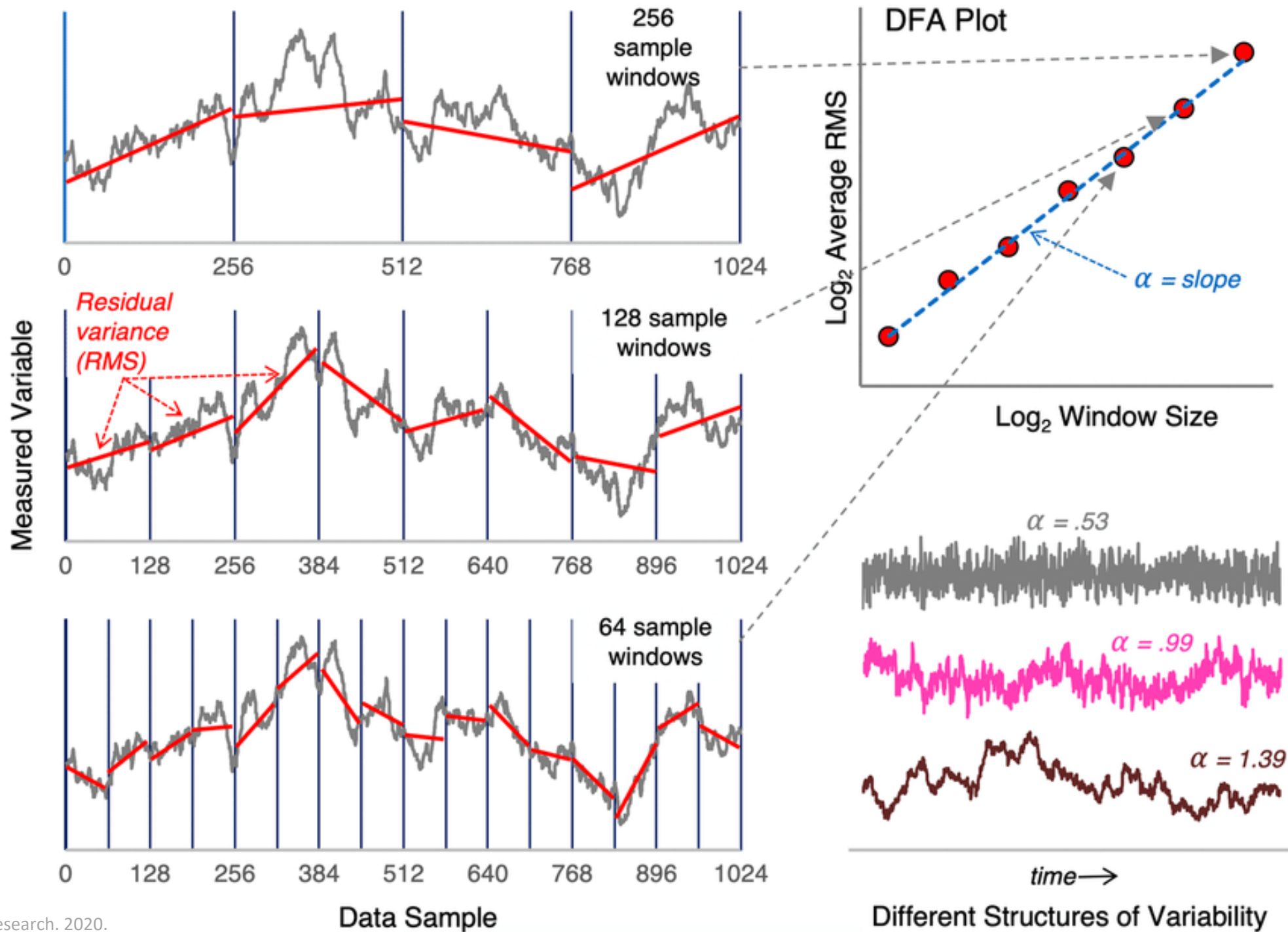
Long-Range Temporal Correlation

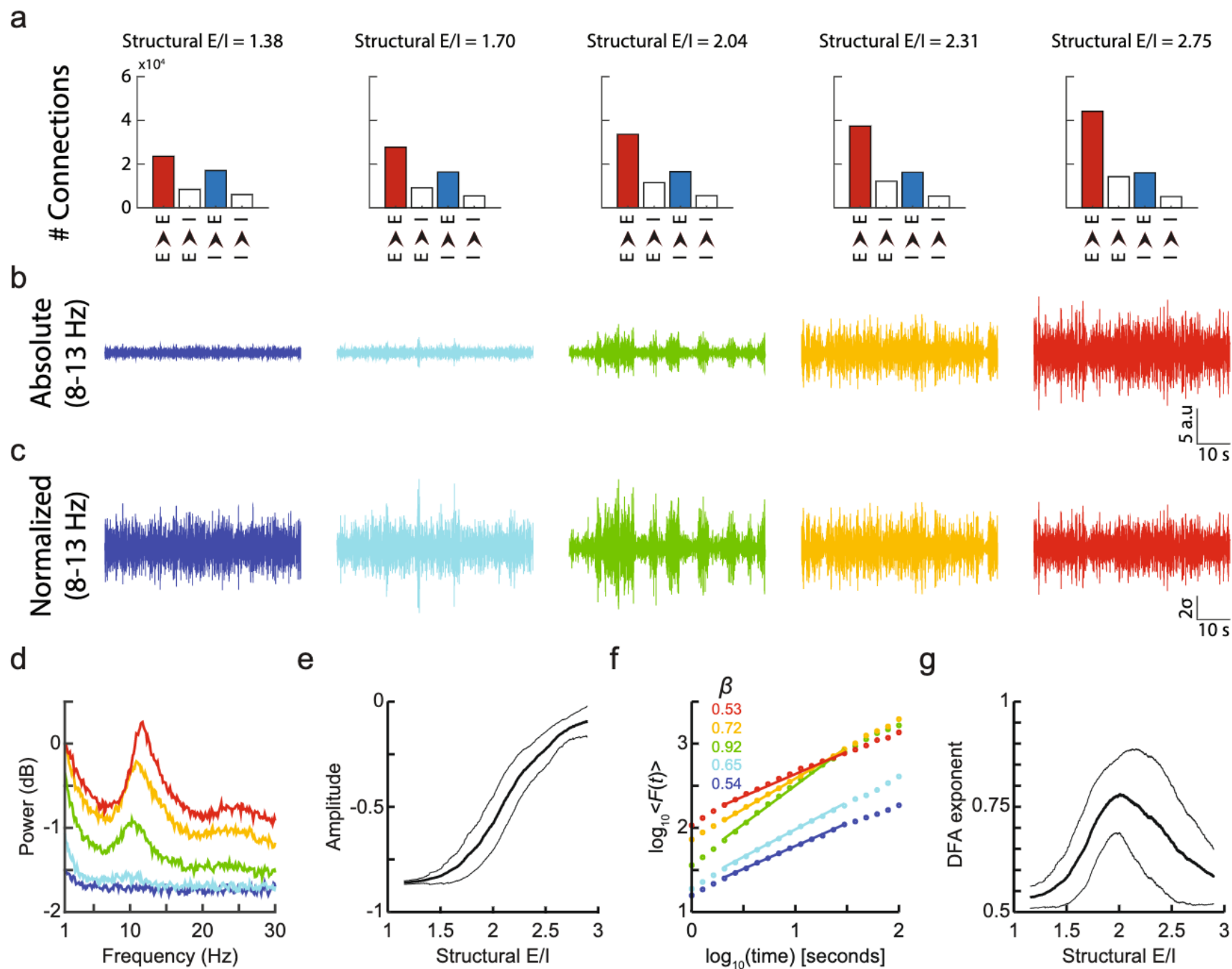
- Temporal autocorrelations of the power in oscillatory bands persisting over different time windows
- Reflects a balance between stability and flexibility in neuronal assemblies
- Emerges in neuronal networks with balanced excitatory and inhibitory forces
- Maximal when E/I is in balance



Detrended Fluctuation Analysis (DFA)

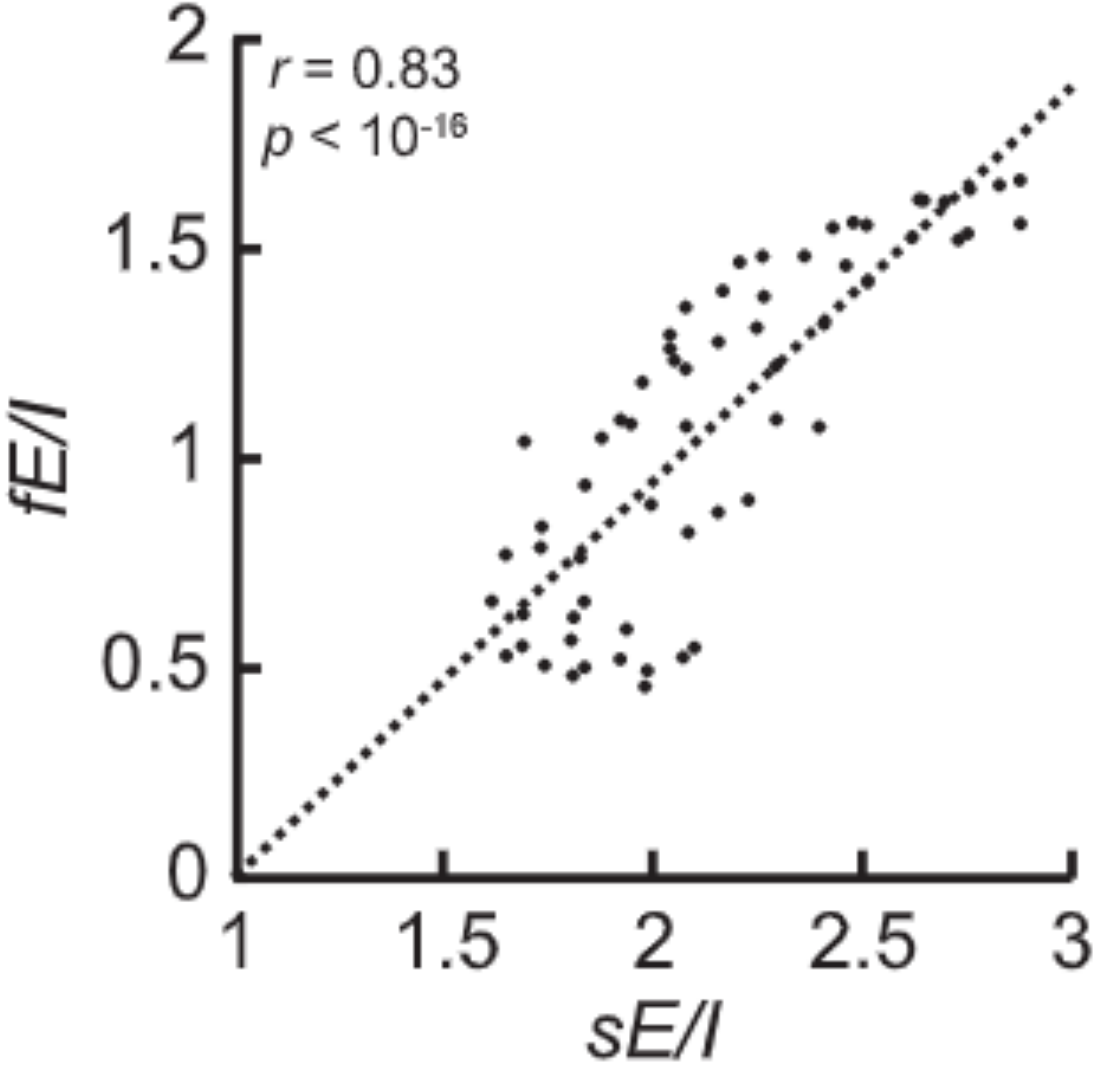


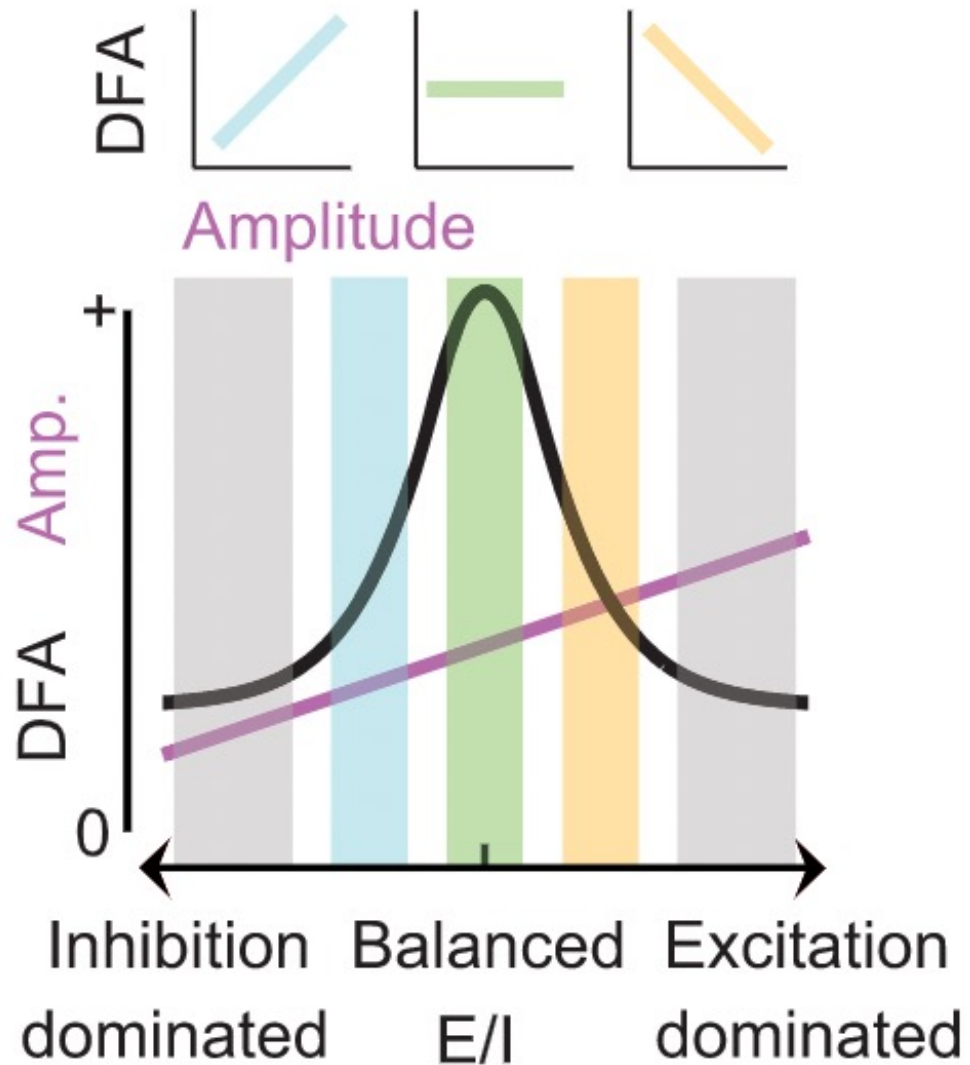




- Increasing oscillation amplitude with increasing structural E/I (e)
- DFA exponents show an inverse u-shaped relationship with structural E/I (g)

Functional E/I is highly correlated with structural E/I





Similar LRTC (quantified by DFA) can be produced by two networks with different sE/I . In the blue area, increasing LRTC correspond to increasing amplitude of oscillations, in the orange area decreasing LRTC correspond to increasing amplitude of oscillations.

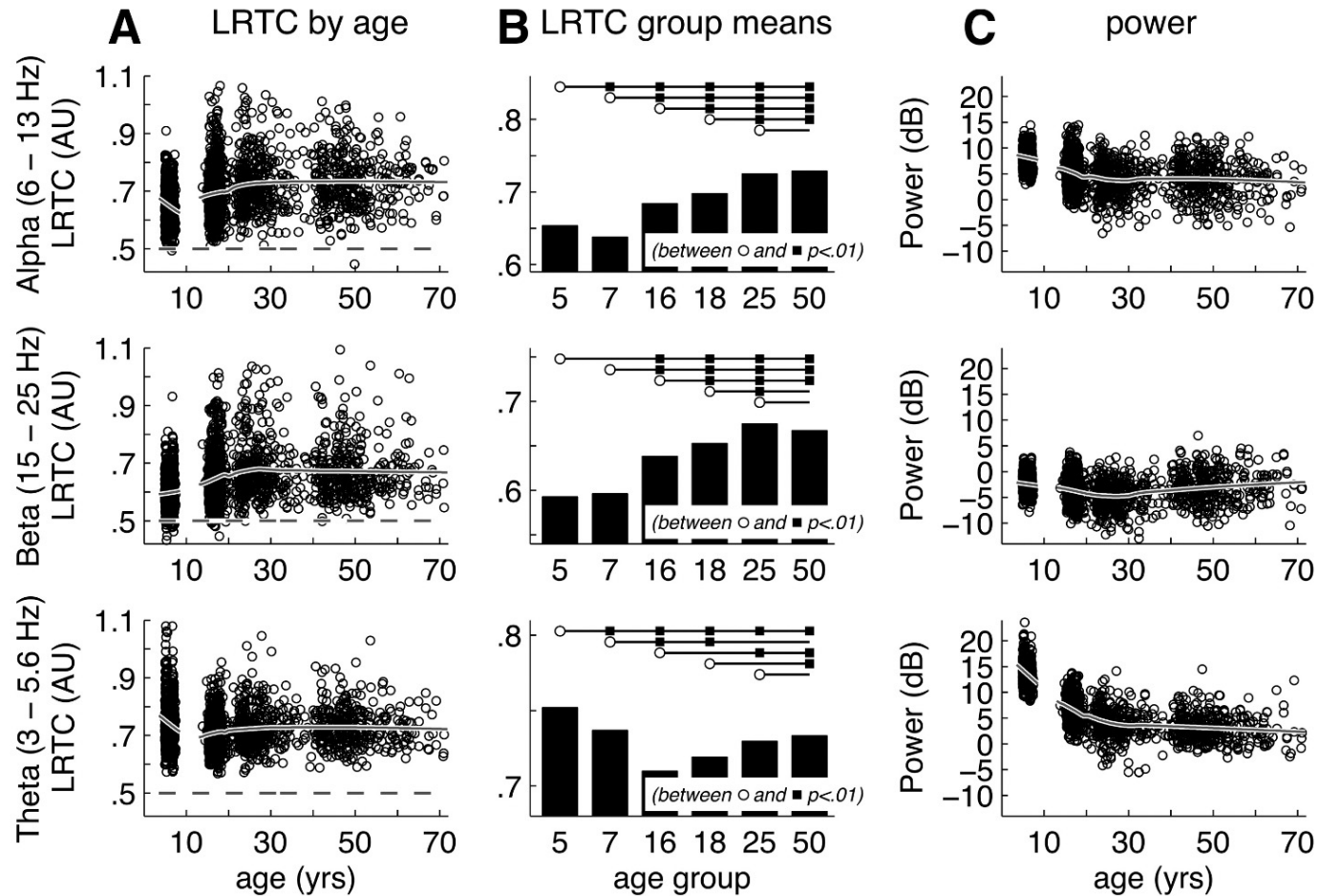
Correlation between amplitude and DFA = functional E/I balance

Higher correlation \rightarrow balanced E/I



Criticality in Neurodevelopment

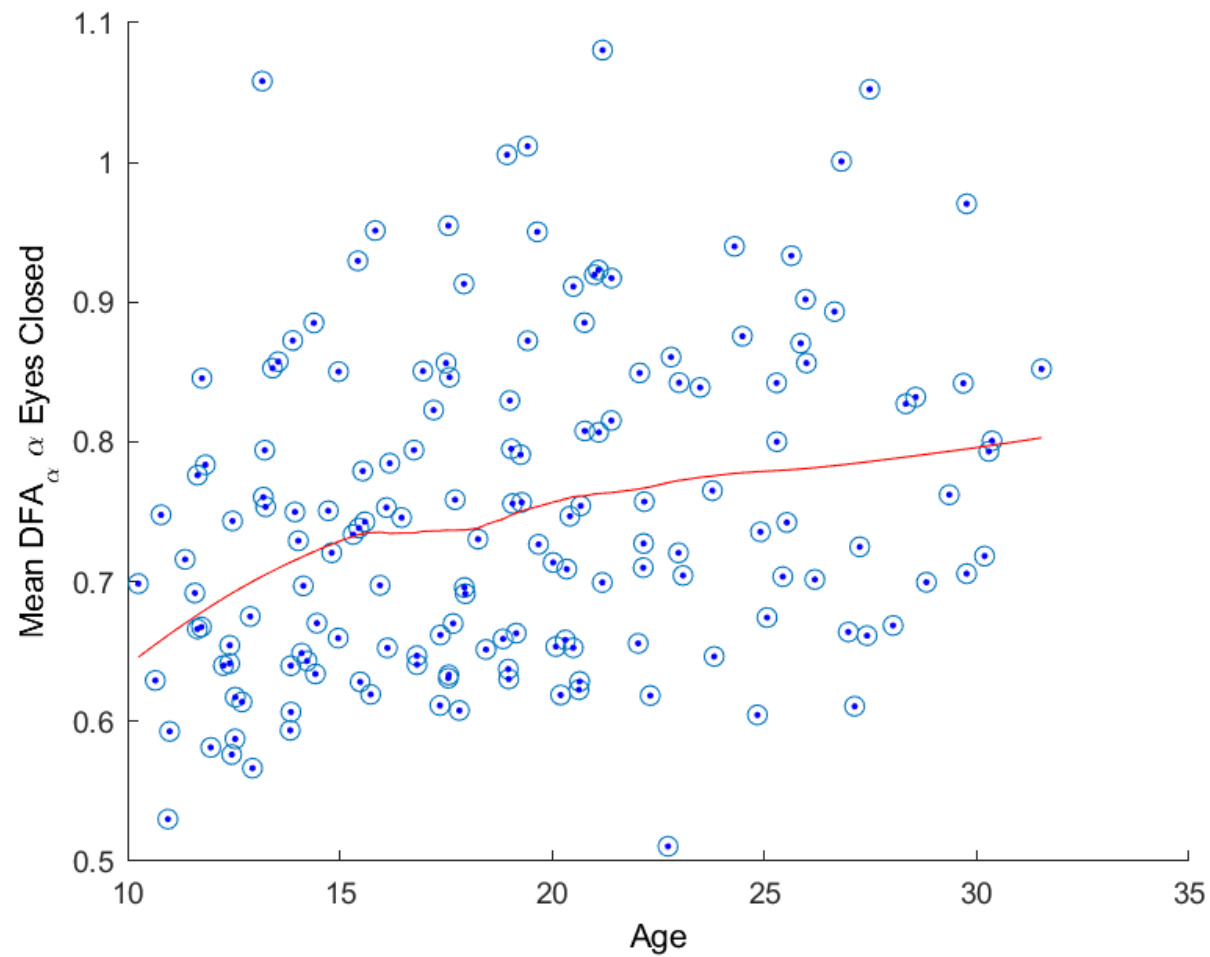
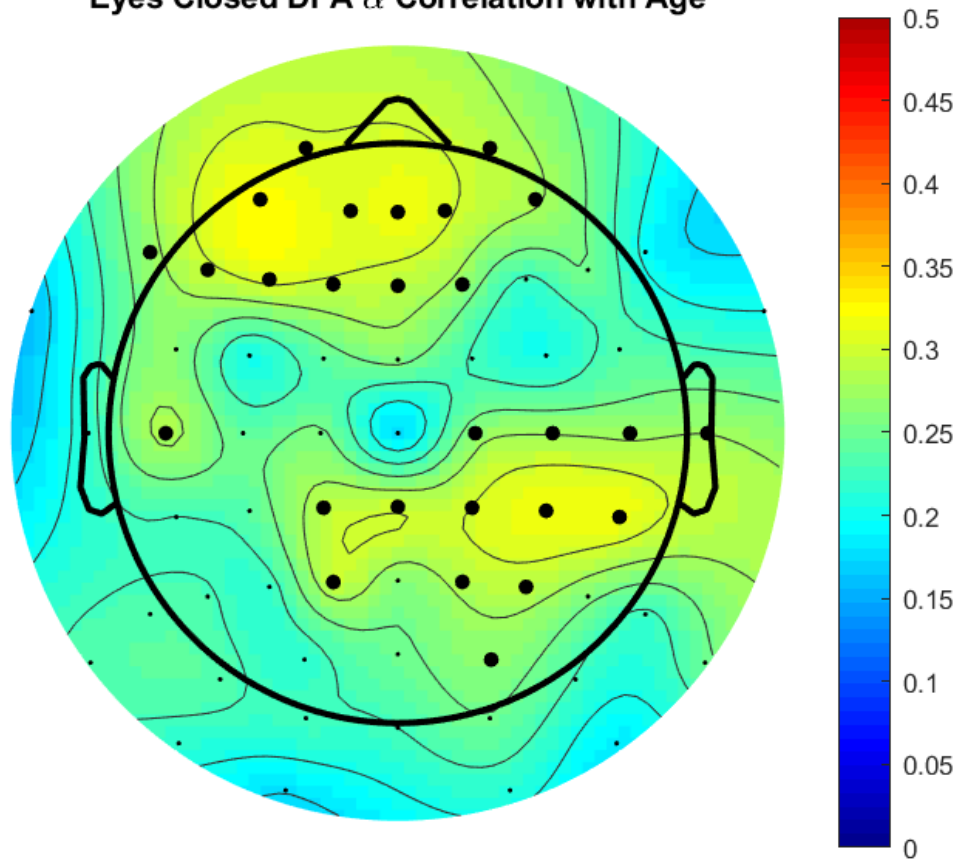
Strong increase in LRTC up to ~ 25 years, then stabilized



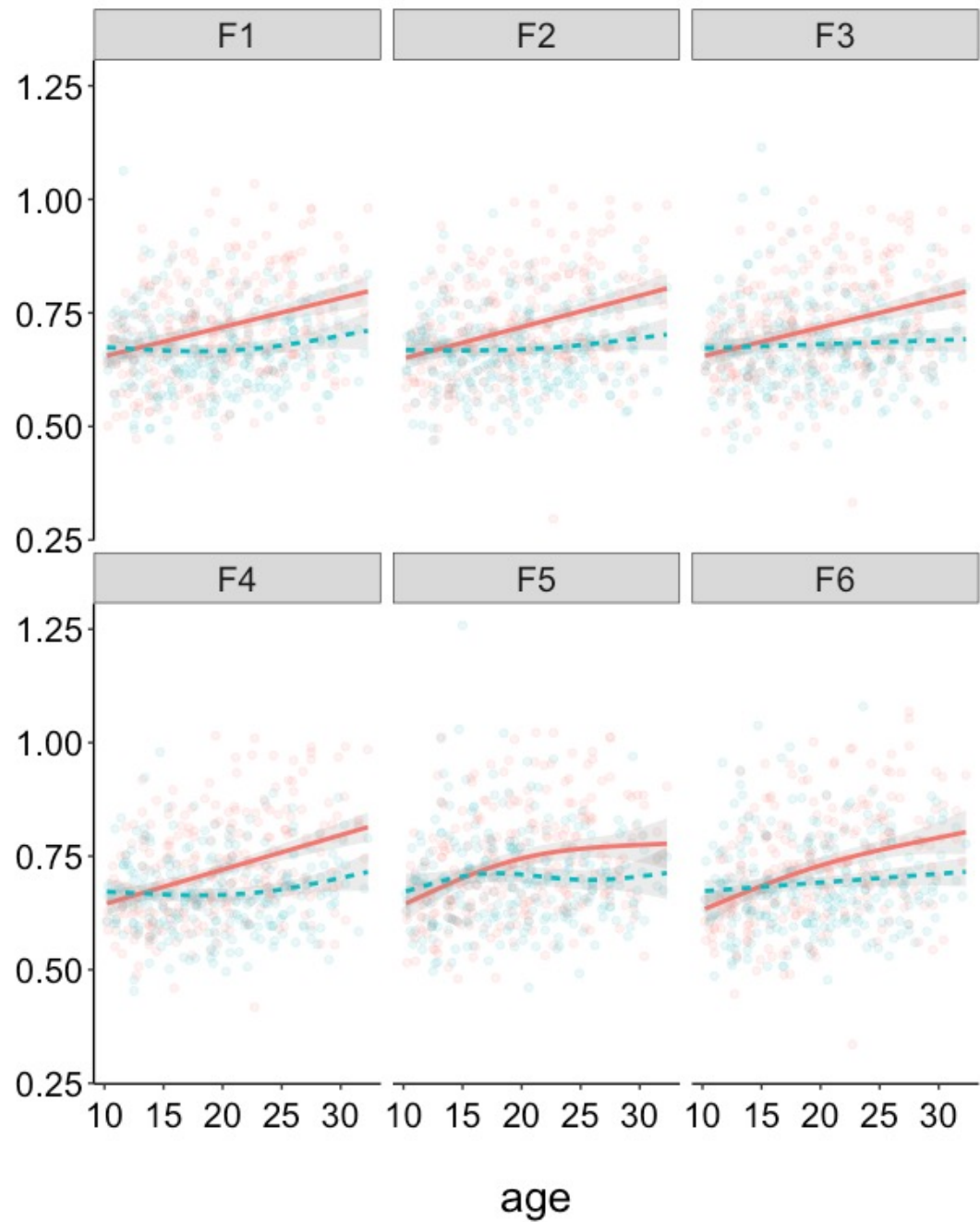
Long-range temporal correlations of activity occur when the neuronal network is near the critical point

DFA is an index of long-range temporal correlations and serves as an indirect measure of functional E/I balance

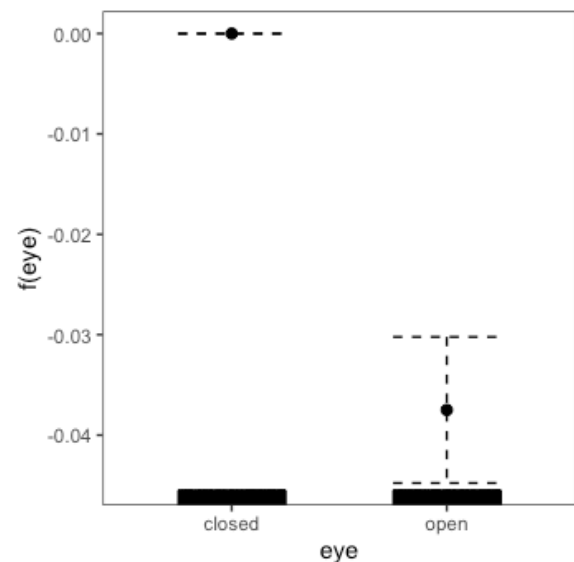
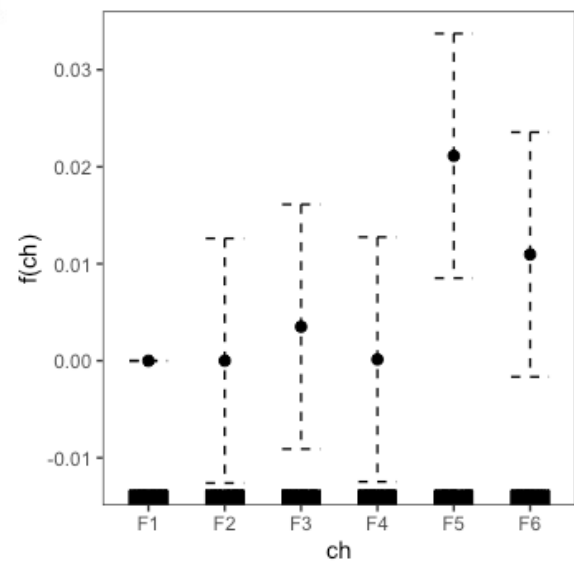
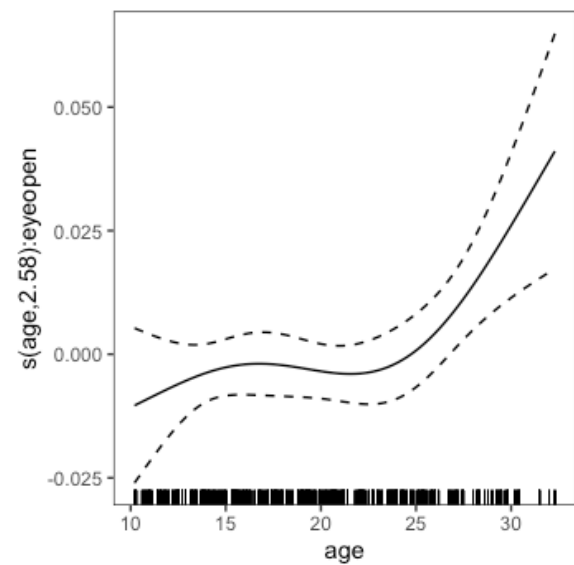
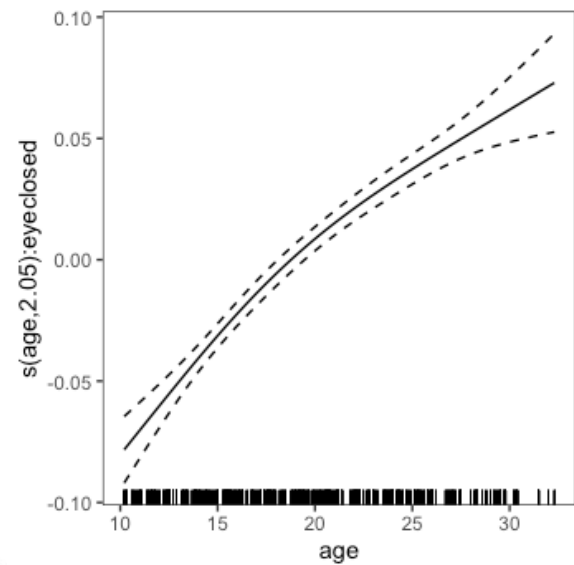
Eyes Closed DFA α Correlation with Age



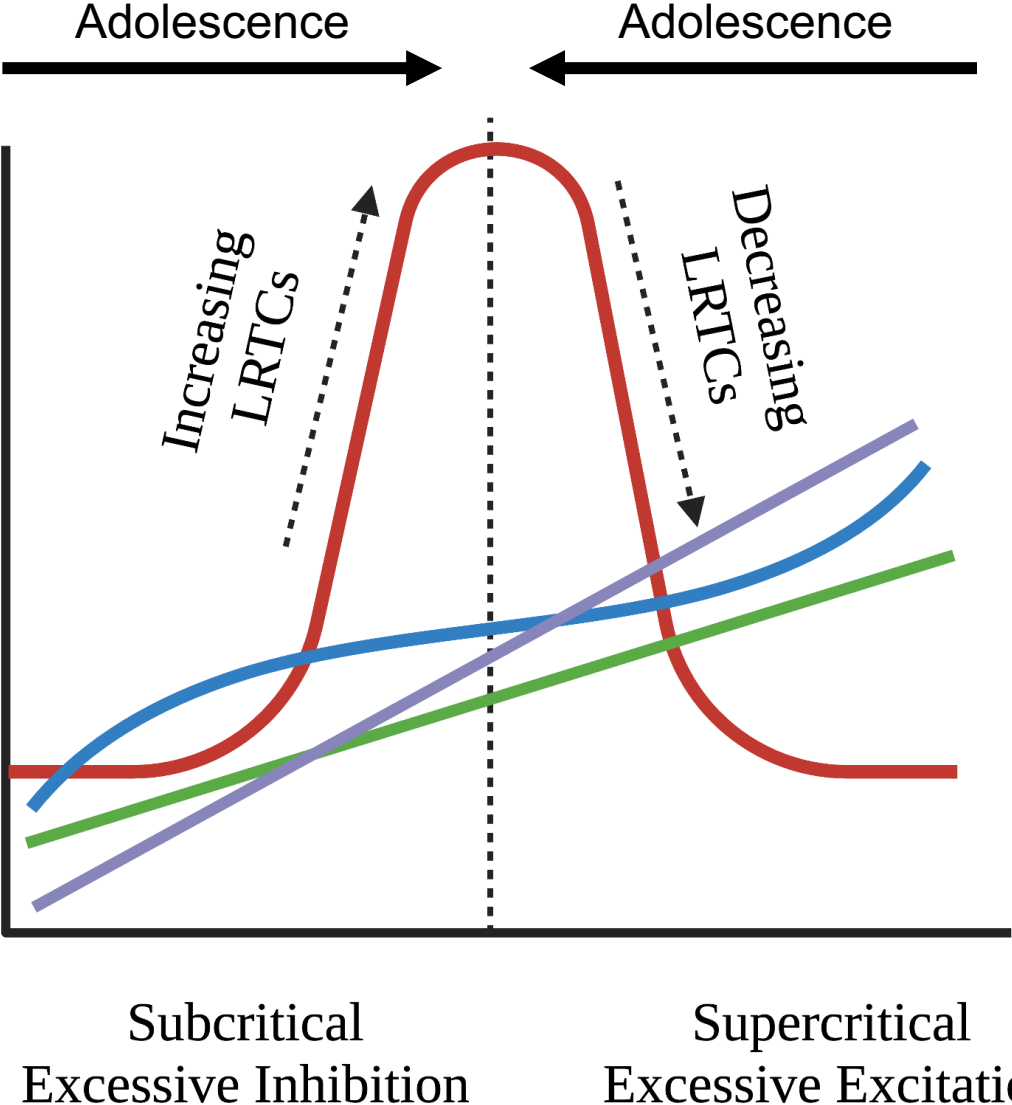
DFAbeta



eye
 — closed
 - - open



Critical brain state means having flexibility to flip between brain states and integrate activity across distant cortical regions



Eyes closed resting state activity exhibits characteristics of a more “critical” state as you age

- DFA
- Oscillation Amplitude
- Structural E/I
- Functional E/I

