

Event-related EEG/MEG synchronization and desynchronization: Basic principles

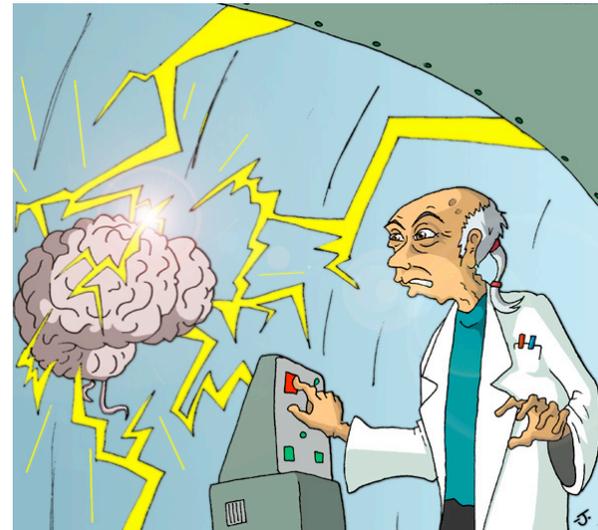
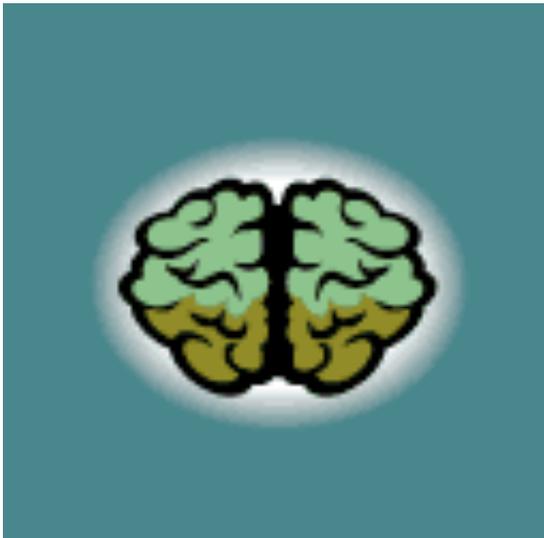
Pfurtscheller, G., Lopes da Silva, F. H. (1999). *Clinical Neurophysiology*, 110
1842-1857.

Summarised by Yatin Mahajan

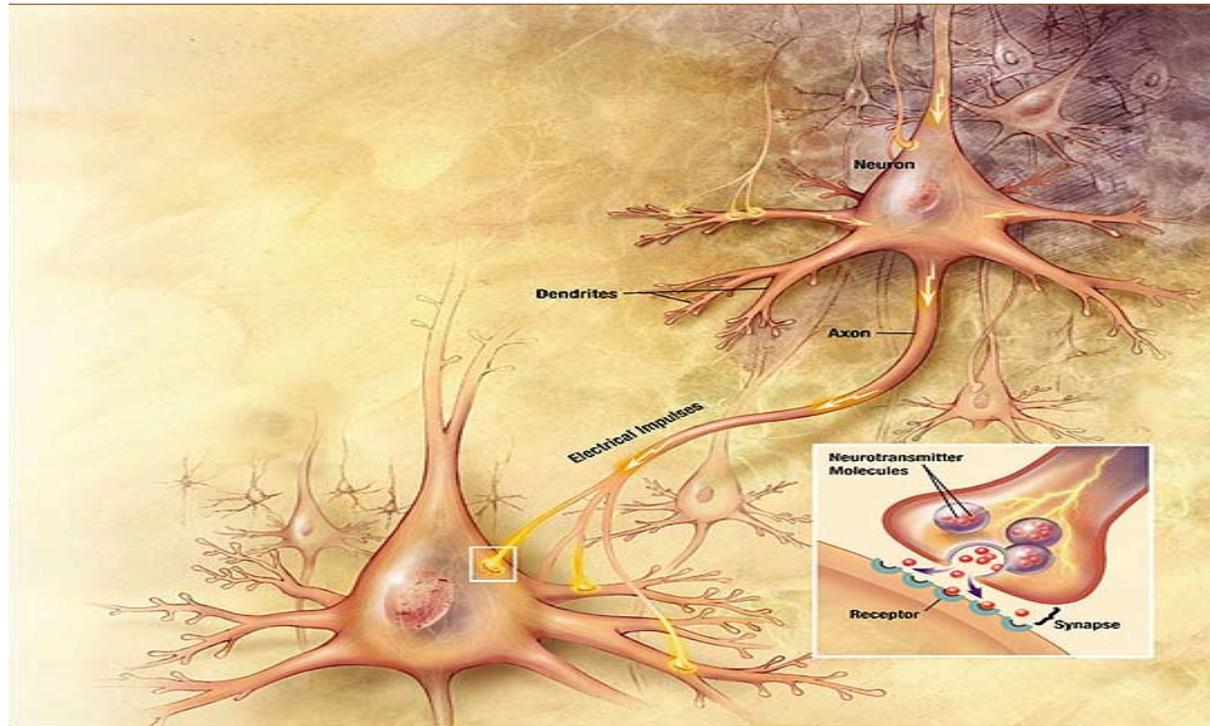


EEG is recording of electrical activity from the scalp produced by firing of neurons within the brain

Refers to the brain's spontaneous electrical activity (resting) over a short period of time



How EEG is produced?

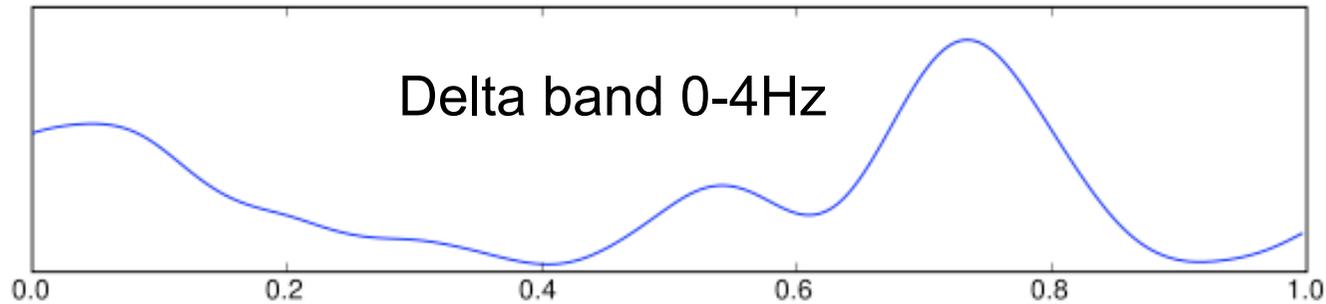


Activity by EEG- electrical potential by post synaptic current

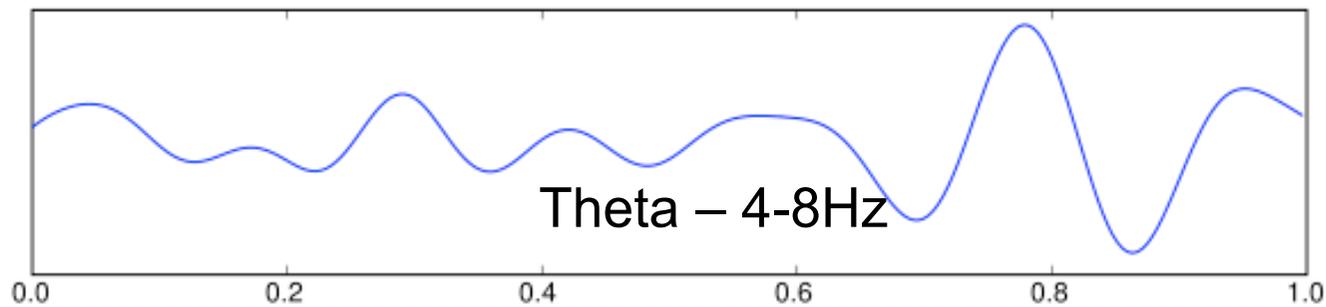
EEG is summation of firing from millions of neuron of similar orientation (radial)

EEG is outcome of oscillations of neuronal assemblies (firing) which occurs at different frequencies.

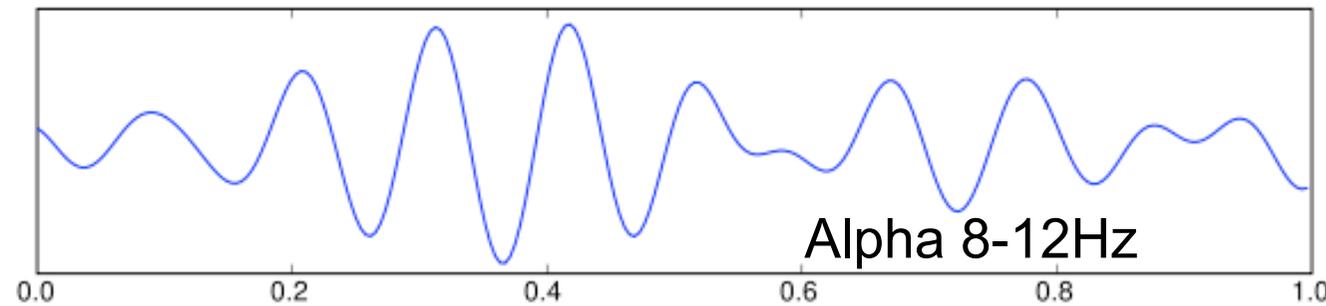
Commonly known as **EEG Rhythms**



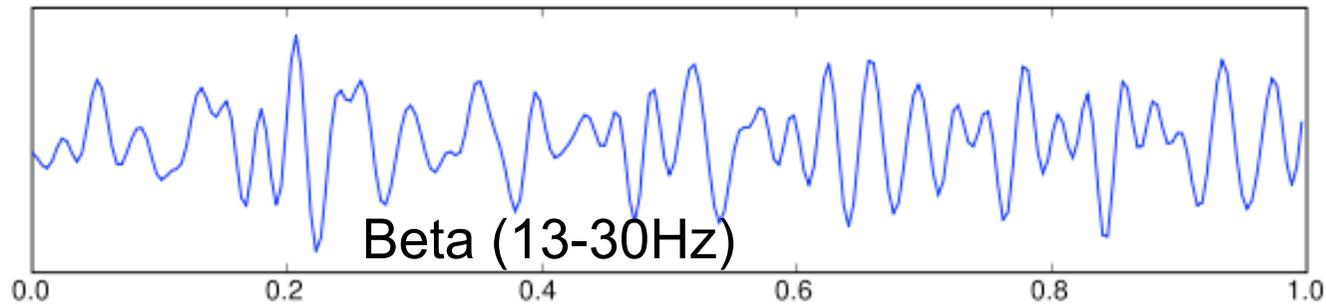
Central region



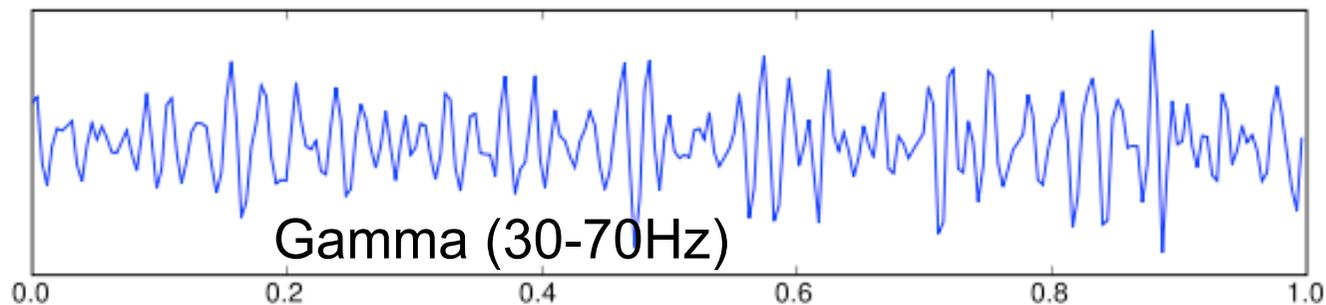
Hippocampus



Visual cortex



Motor cortex



These rhythms are measured in terms of Power spectrum

Power (amplitude)

- the synchronicity with which a given neuronal assembly (oscillates)

EEG is filtered through different band pass filters and Fast Fourier Transforms to obtain the spectral power in a band

ERD & ERS

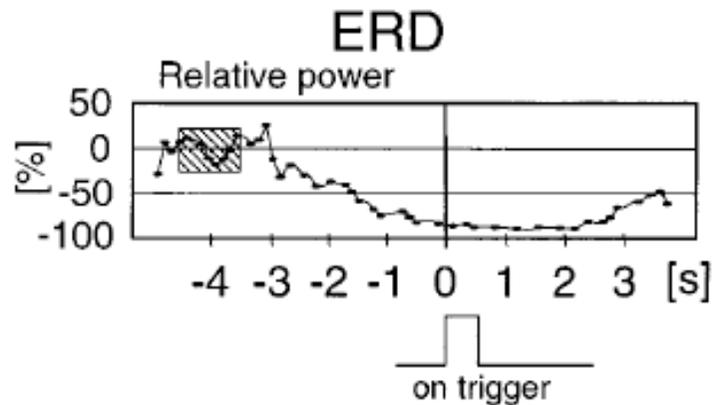
decrease in power in a frequency band = Event related desynchronization (ERD)

Increase in power in a frequency band = Event related synchronization (ERS)

Usually expressed as % power change for different frequency bands

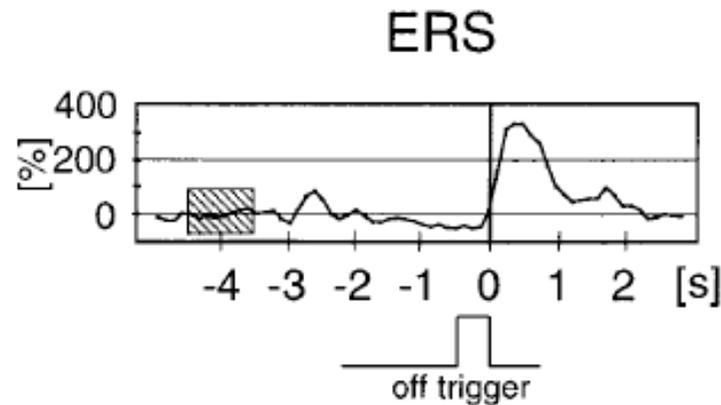
Calculated with reference to baseline period of some seconds

Changes in the power spectrum of different frequency bands before during or after an event reflects changes in firing pattern of neurons (group)



Stimulus is ON

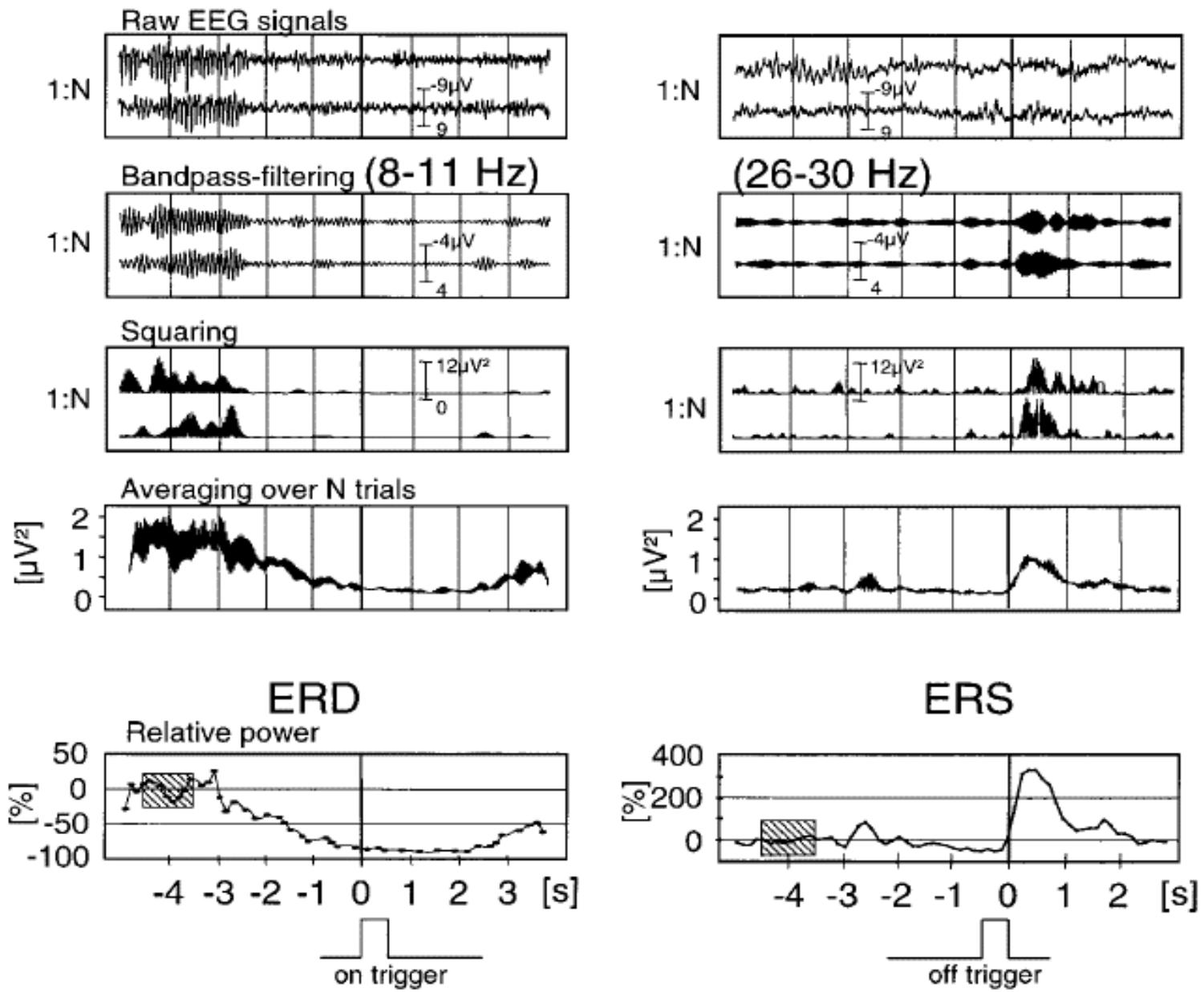
localized area



Stimulus is OFF

wide spread activation

How to record ERD and ERS



Interpretation of ERD and ERS

ERD:

- Electrophysiological correlate of activated cortical areas involved in process of sensory or cognitive information or pre programming during execution of a task and production of motor behavior

- Increased ERD in a band or widespread ERD -large neural networks or more cell assemblies

complex tasks

more efficient task performance

more effort put

in case of elderly participants and patients

- Reduced ERD – small neuronal assemblies working in desynchronized manner

- ERD reduced in motor learning tasks over a period of time and it becomes localized

ERS:

When a patch of neurons shows increase in power in a band – no active processing (most often)

ERS in gamma band is associated with active information processing (motor tasks)

Introduces powerful inhibitory effects which could act to block over excitation e.g. blocking a memory or visual search from entering irrelevant parts of neural networks

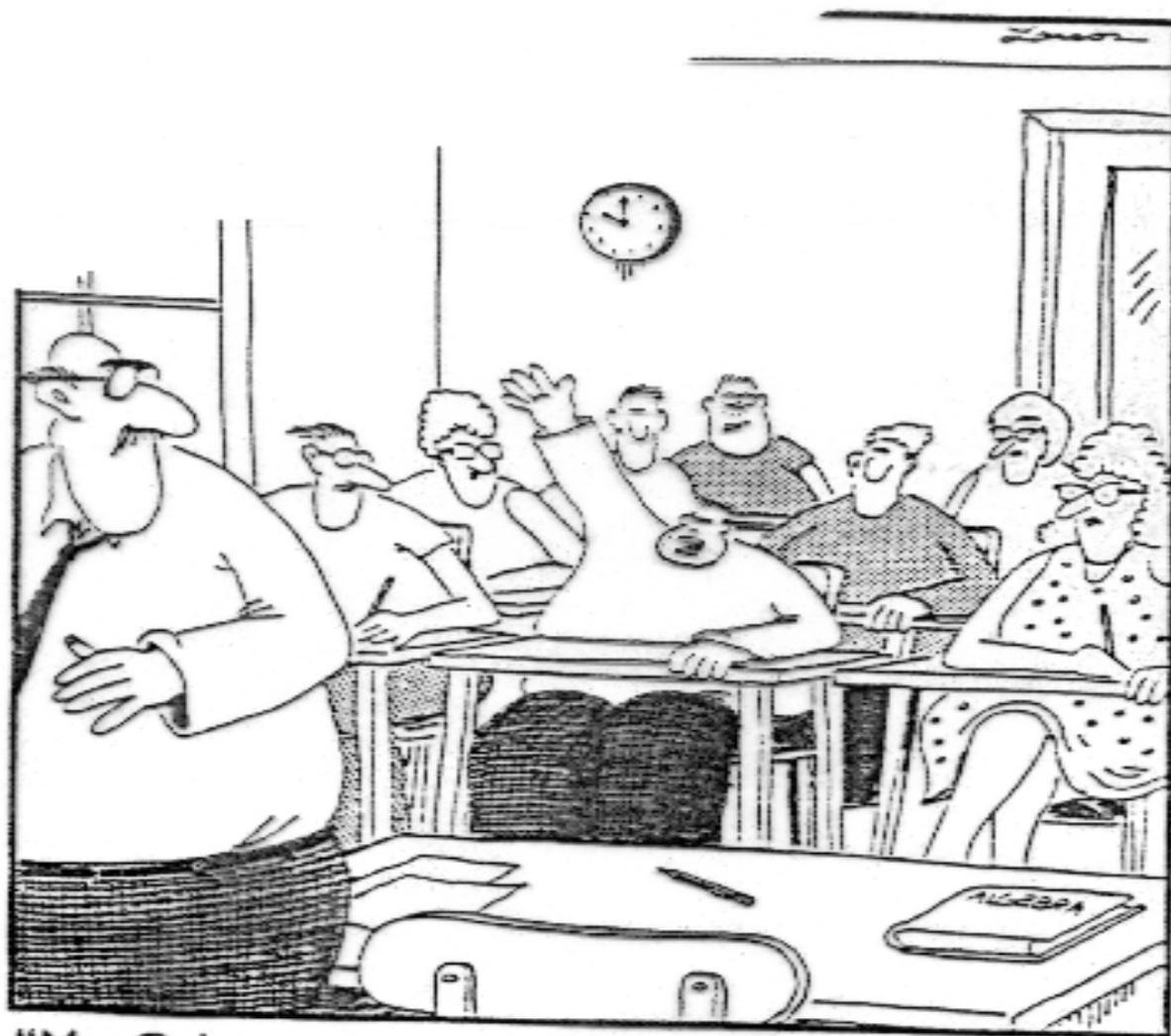
Sometimes to define a stimulus , category judgment tasks

ERD/ERS in neurological disorders:

Quantification helps in diagnosis of functional deficits in cerebrovascular disorders and Parkinson's Disease in which ERD is abolished or reduced

Differentiation between surface and deep vascular lesion (voluntary hand movement tasks)

ERS is believed to be associated with recovery of function of primary motor area lesion



"Mr. Osborne, may I be excused? My brain is full."