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From EEG to ERPs and Visual Word Recognition

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2015 Global Education Summit

@USAIDEducation

#LetGirlsLearn

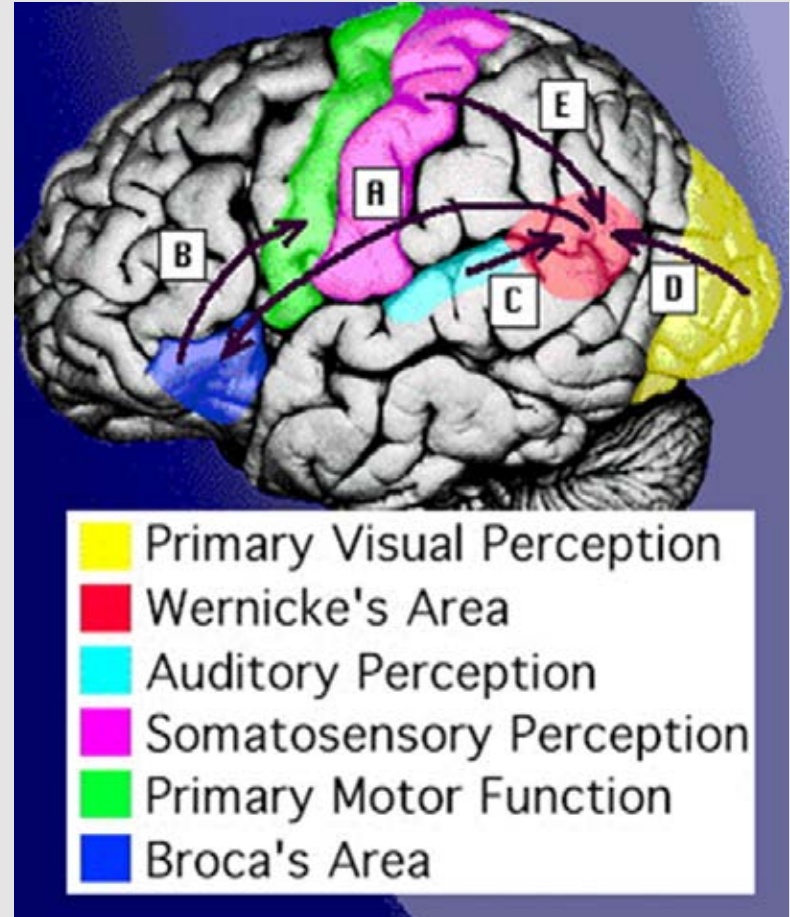
#endpoverty

Functional Brain Activity

Our cognitive, sensory and motor behaviors are controlled by functional brain activity

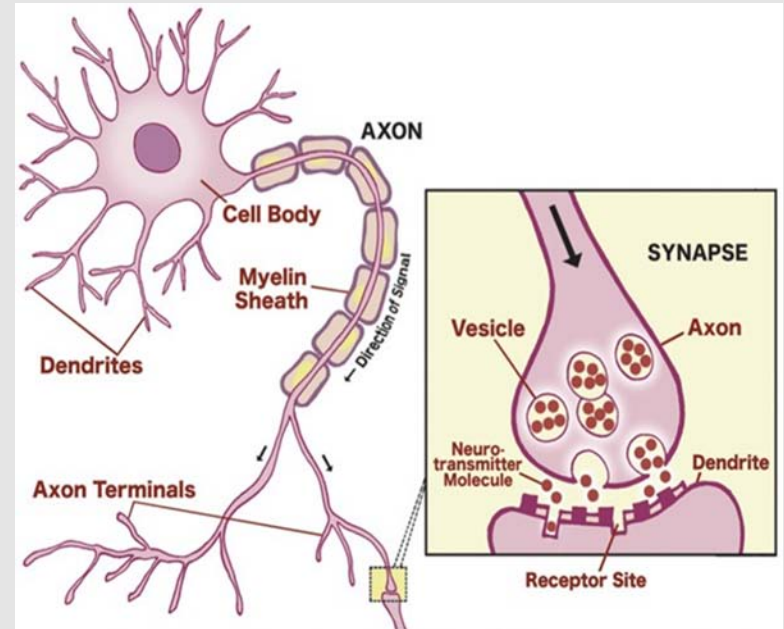
Brain areas are composed from billions of neurons.

Different brain systems work cooperatively during cognitive processing, motor control and while acting out different behaviors.

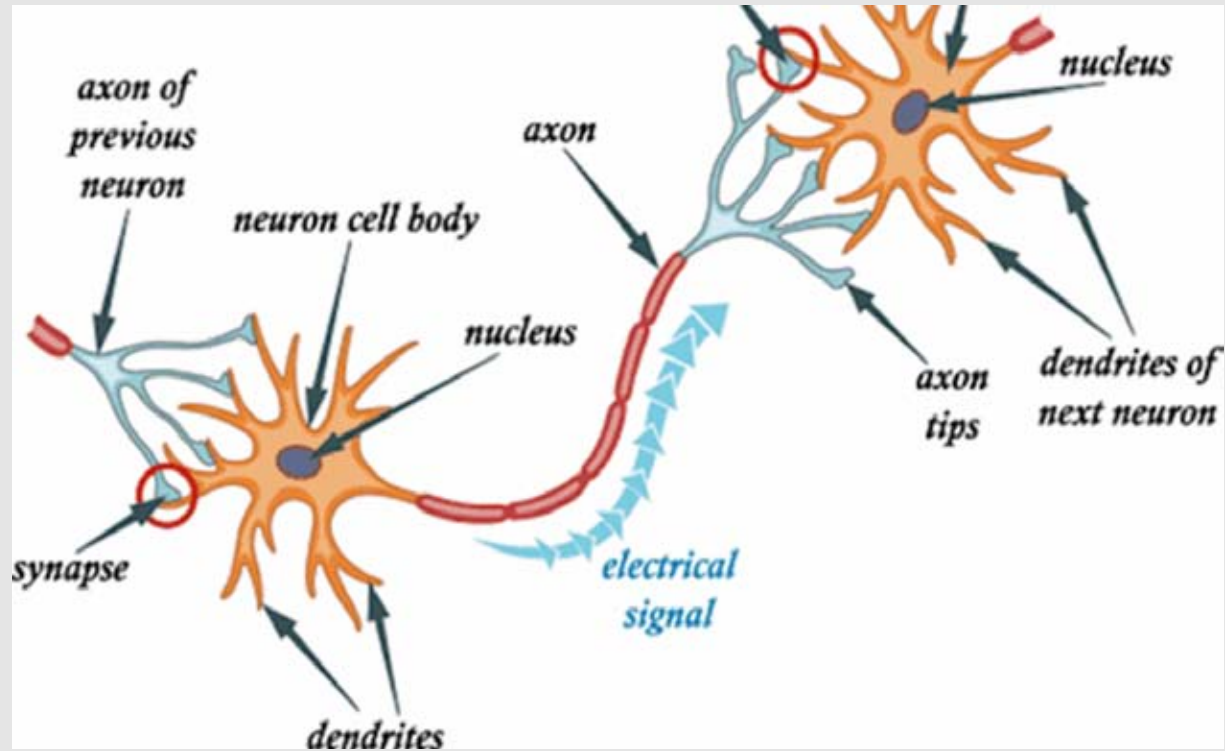


Neural activity and communication

- Neurons communicate using neurotransmitter release from axon terminals of the pre-synaptic neurons to the dendrites of the post-synaptic neuron
- This process produces changes in the ions concentrations both inside and outside the neuron membrane, and accordingly reveal into voltage changes in the post synaptic dendrites
- This post synaptic potential reflects the existence of neural activity which maybe related to cognitive or other behavioral process



Neural activity and communication



What is EEG?

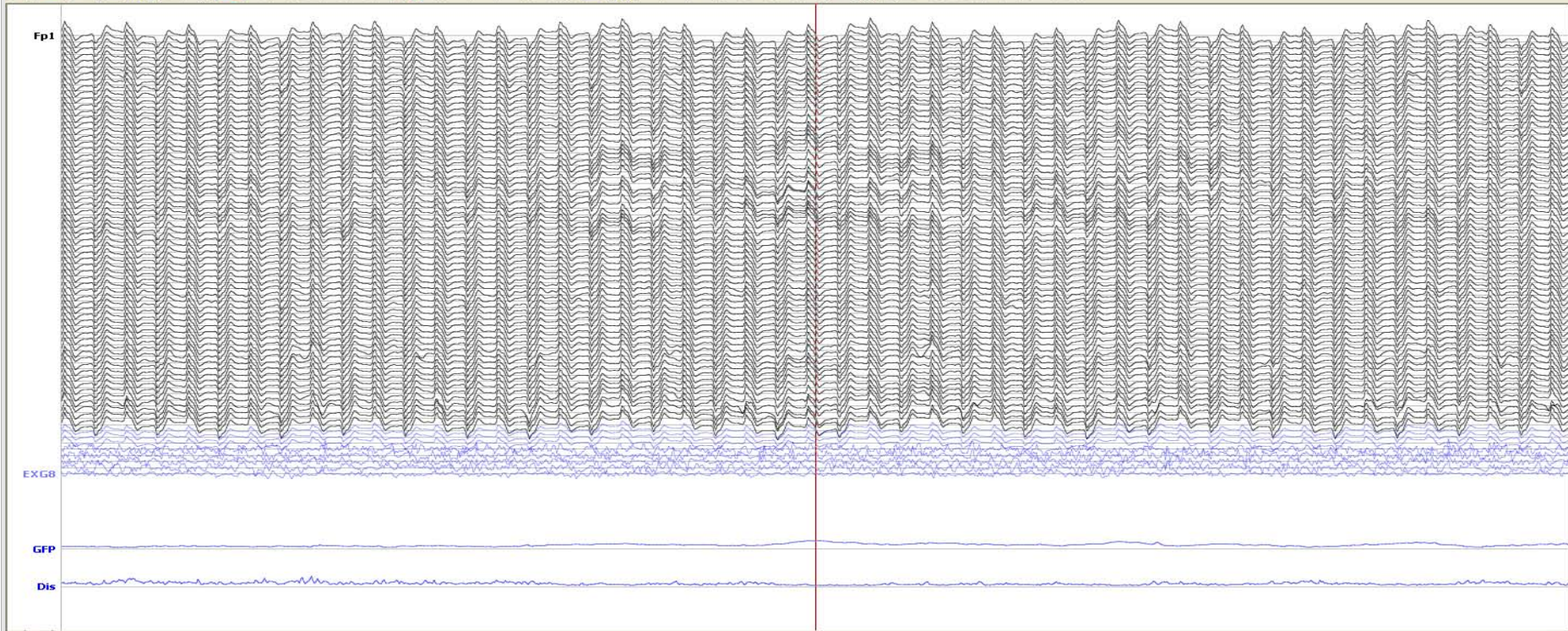
- The post-synaptic dendrites potentials could be projected to the scalp as weak electrical waves
- We can record the ongoing changes in the voltage of these waves by placement an electrodes on the scalp
- This recording technique is known as: **electroencephalogram (EEG)**



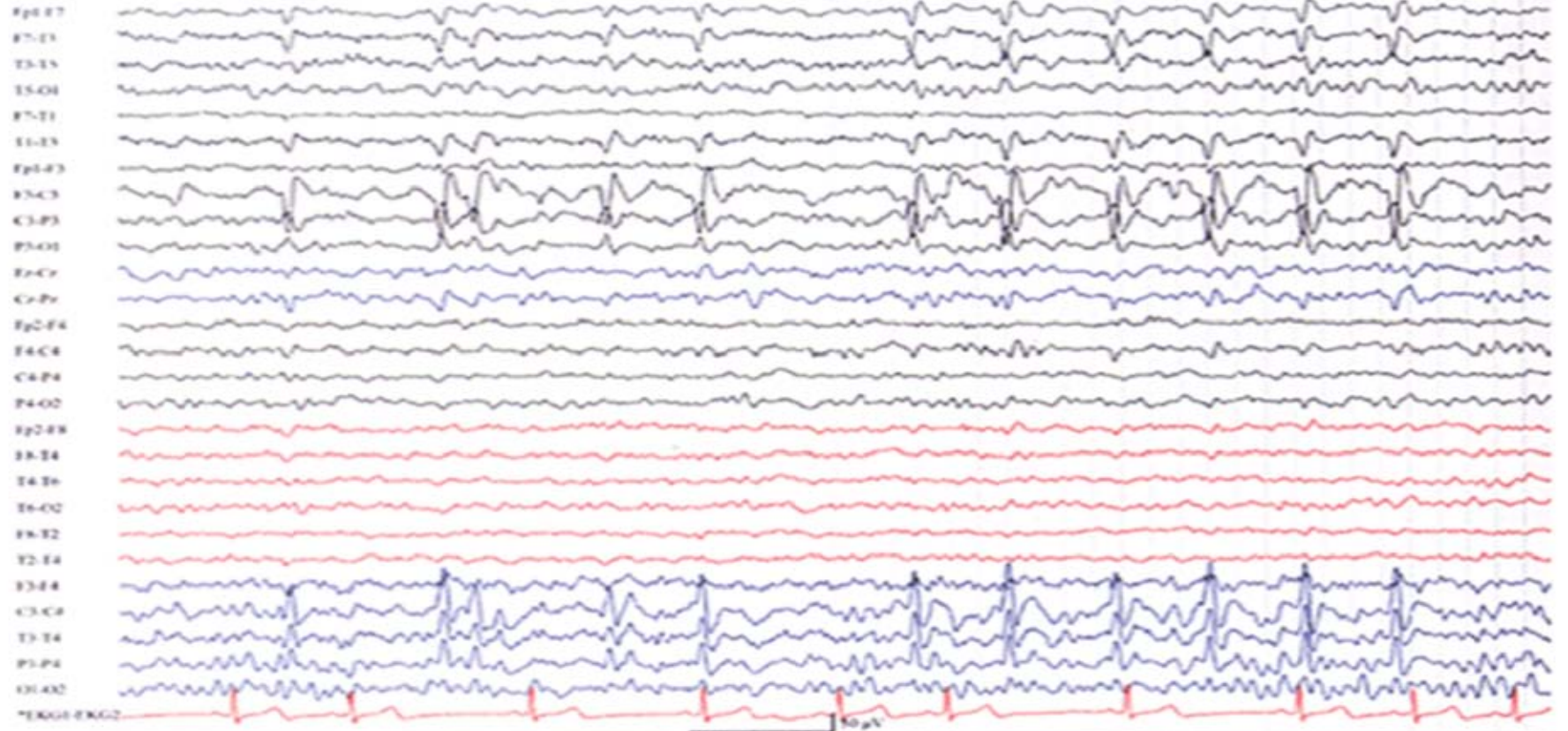
EEG

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File Tools Edit Selection Markers Options Window Help



Filtering

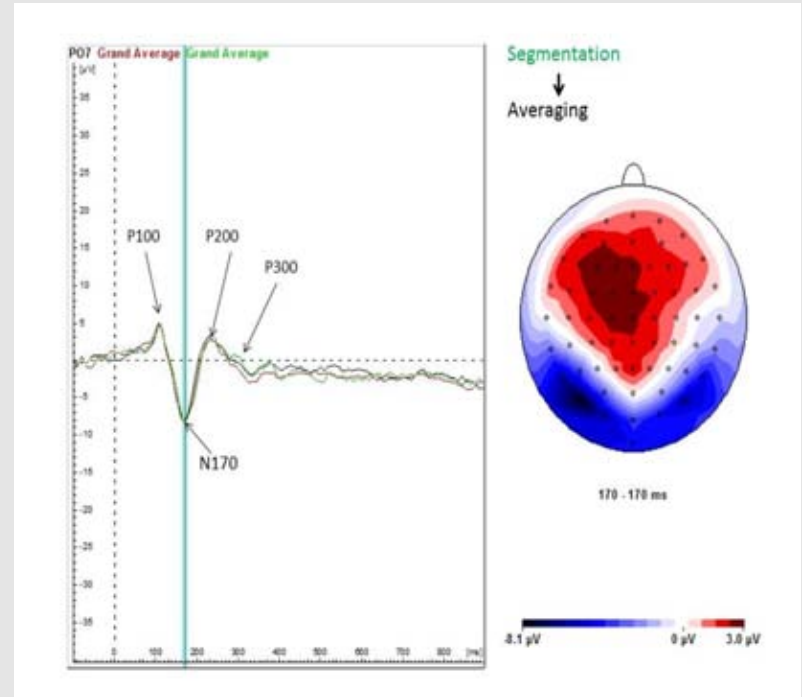


ERP

ERPs are being extracted after the EEG recording through a complex process of analysis of the brain waves that were recorded and after filtering artifacts and noise.

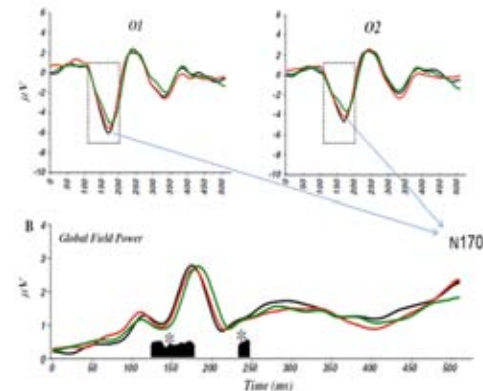
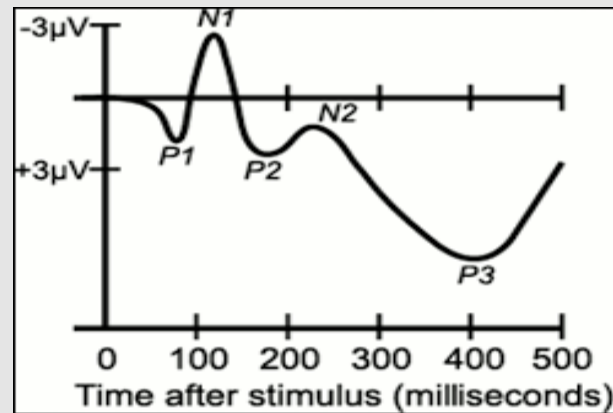
We can measure different changes in the voltage peaks for different time points during the time course of processing.

These peaks represent the ERP components which were found to represent changes in the brain activity that is related to different stages of processing.



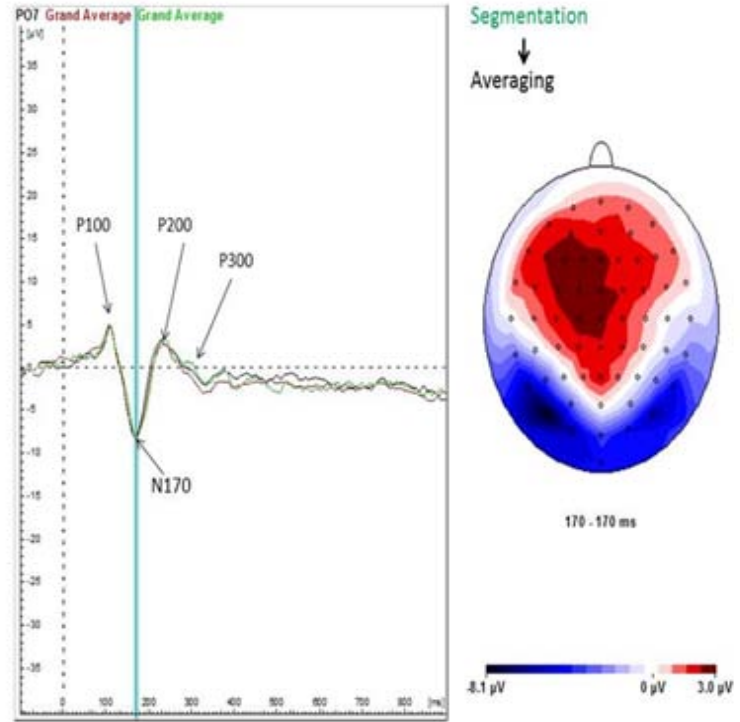
ERP-bis

- ERP waveforms are typically described in terms of positive and negative peaks
- Labeling refers to the sequence in which the peak occurs and to its polarity. For example, N1 would refer to the first negative peak in the waveform, and P2 would label the second positive peak
- ERP components can also identify the positive and negative peaks by their latency
- For example the N170 component is a negative polarity that usually measured on occipito-temporal sites on the scalp and usually peaks in the time window of 170ms post visual stimuli onset



ERP components and reading research

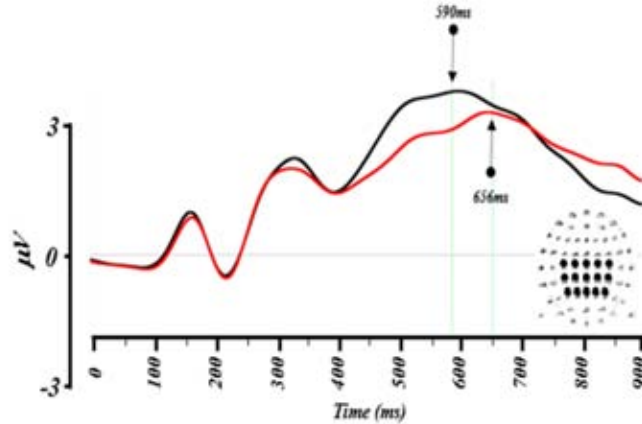
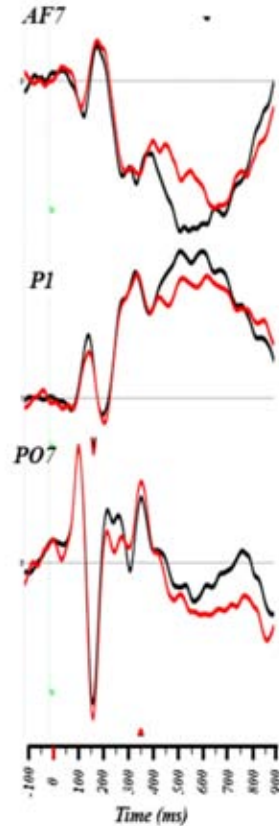
N170: is a negative polarity that usually measured on occipito-temporal sites on the scalp and usually peaks in the time window of 170ms post visual stimuli onset. This component represents the earlier stages of visual processing (orthographic stage) of word recognition. Variations in such component that were measured between typical and dyslexic readers were attributed to poor orthographic processing skills among the dyslexic readers



ERP components and reading research

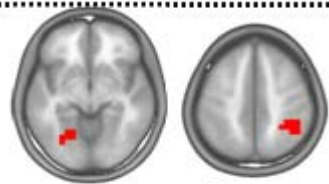
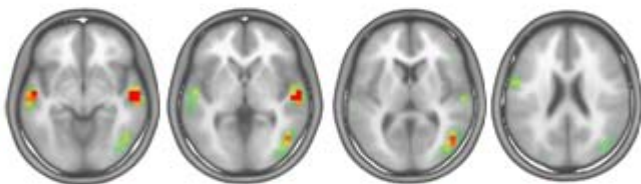
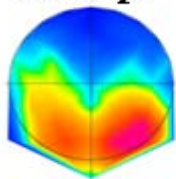
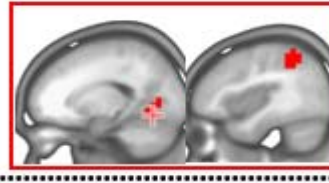
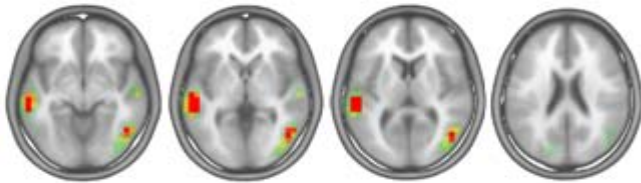
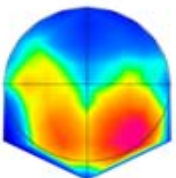
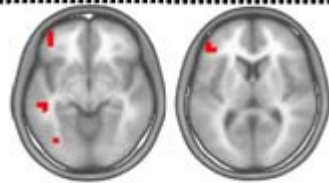
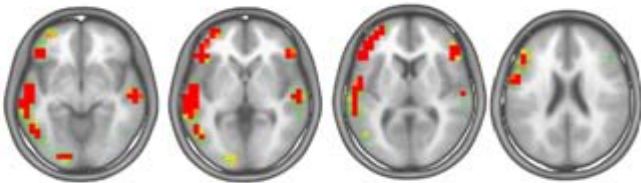
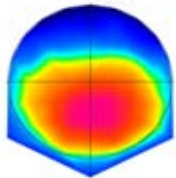
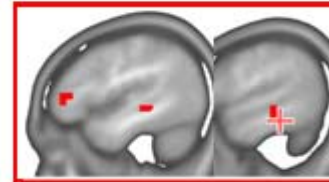
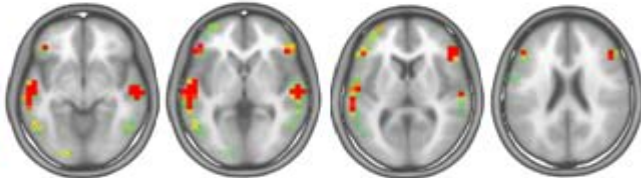
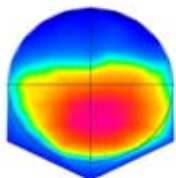
- **P200:** represents a positive peak around 200ms post stimuli representation. this component was found to be related to earlier analytic orthographic processing (Taha & Khatib, 2013).
- **P300:** The positive peak that occurred 300msec onset. P300 amplitude is affected by the amount of processing resources being consumed and reflects reliance on working memory (in decoding of pseudowords or non familiar words).
- **N320:** This component represents negative polarity that peaks around 320ms post stimuli presentation and consistently being measured during phonological processing and phonological decoding tasks. Modulation of this component represents modulation in the phonological processing.
- **N400:** This negative component occurs approximately 400msec after stimulus onset and is usually associated with visual and auditory sentence comprehension tasks.
- **P600:** This component has two functionally different interpretations, one associated with memory processes (e.g. orthographic decisions) and another related to language (like syntactic anomalies).

ERP analysis-bis



P6: Significant main effect of condition
($F(1, 14)=21.53, p<.0004$),

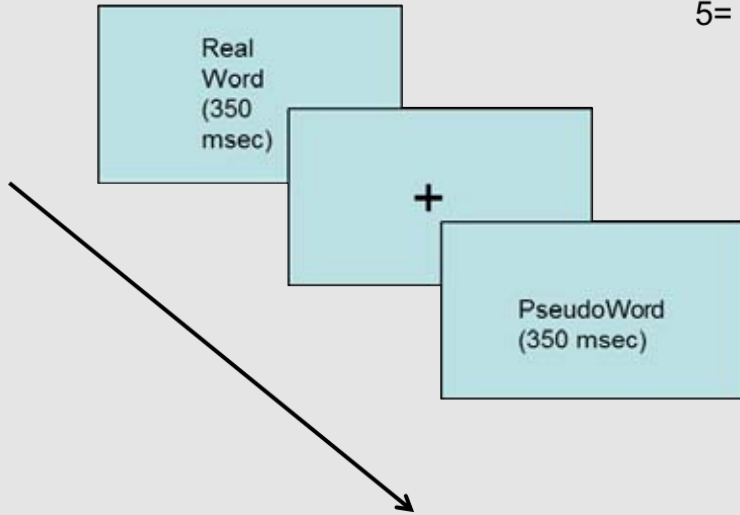
Latency: $t=-2.73, df=14, p<.02$

A**P2 maps***Words**PHom.***B****P6 maps***Words**PHom.*

Classical Experimental Tasks

Lexical Decision Task

Press
4= word
5= pseudoword



OUR STRATEGY

EXTREME
~~POVERTY~~
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