Emotion $\cap$ Language

Ad Hoc reading group
16 feb 2024

HATE

LOVE

Do you recognize the snake before you feel fear, or vise-versa?

What is the time course of object (word) recognition?

What is the time course of emotion *experience*?

What is the time course of emotion *evaluation*?

Questions of Categorization

Is evaluative different from semantic categorization?

- **H1**: The affective primacy hypothesis
  (Zajonc 1980, 2000, Nummenmaa et al 2010)
- **H0**: The cognitive primacy hypothesis
- **H2**: The context(/Task) sensitivity Hypothesis

What *is* emotion?

- Are they bodily or cognitive events?

humours
(Galen/Hippocratus)

Movements, follow thoughts
(Aristotle)

dualism (body =/= mind)
(Descartes)

monism (body = mind)
(Spinoza)

“*The bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur* IS *the emotion.*”

The Principles of Psychology, James (1890) (Vol. 2, p. 449, italics original)

Emotion ∩ Language

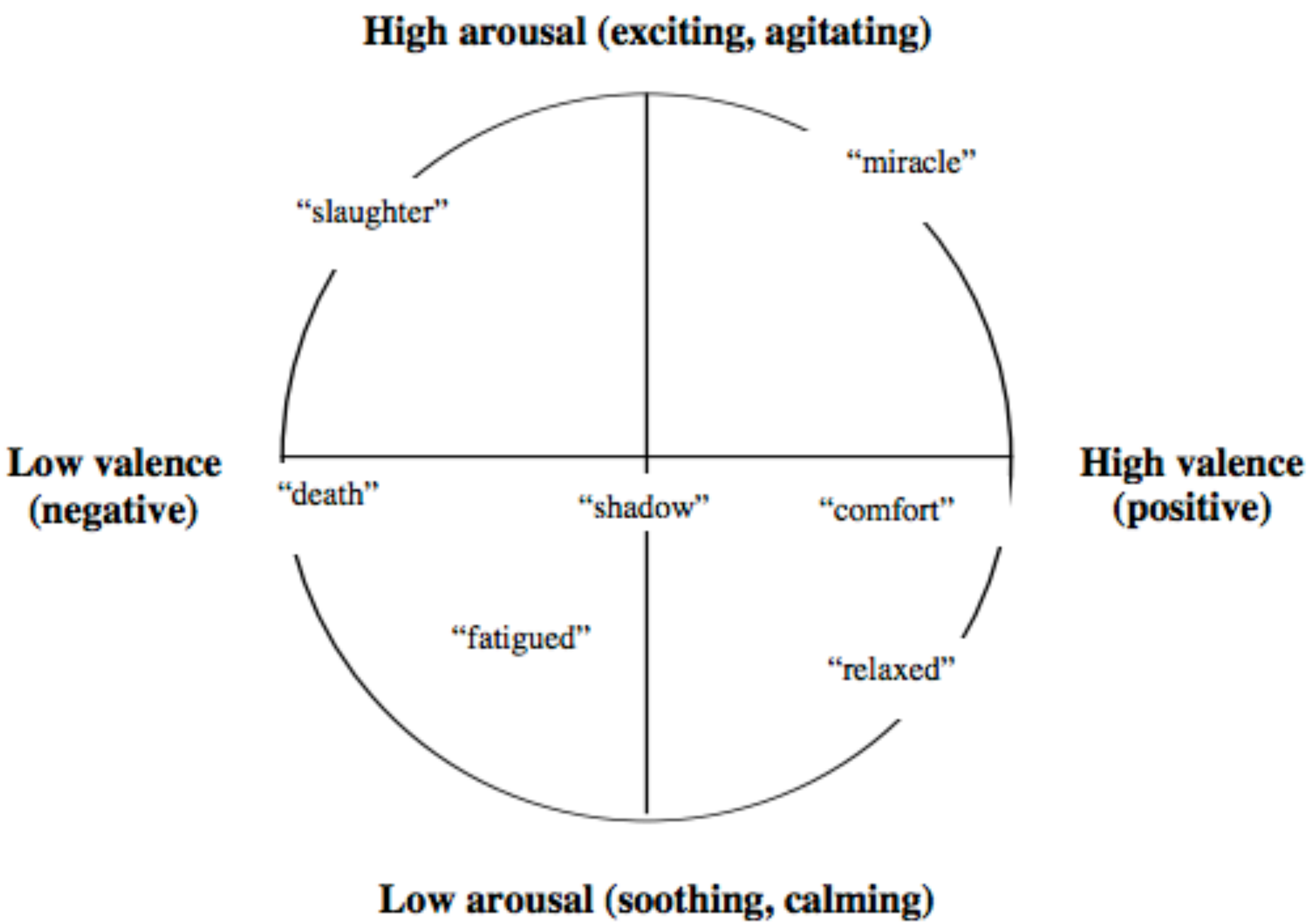
Valence :
is it positive/pleasant or negative/
unpleasant?

Arousal :
How strong is the affect?

Concreteness :
Is the word/concept concrete or abstract?

Imageability….

Figure 1. Affective experiences may be best described in two dimensions: Valence refers to how positive or negative an event is, and arousal reflects whether an event is exciting/agitating or calming/soothing. Words have been placed at locations within this space, indicating their approximate valence and arousal ratings (ratings from Bradley & Lang, 1999 [#11]).



Two aspects

- Experiencing the emotion —-> internal movements in response to external stimuli (evolutionary, adaptive)
—> limbic and autonomous nervous systems

- Representing the situation which led to the emotion (cognizing) and evaluating (appraisal)
—> cerebral cortex

Philosophical issues

- Phenomenology of emotional experience : arousal and valence (core affect)
- Intentionality : are emotional states about something ? (representational)? i.e., are they the same as the cognitive attitudes (thinking, knowing, hoping, wanting…)
- How are emotional states individuated?
- How does emotion interact with reasoning?

CogSci issues

- What are the behavioral implications of emotion?
- How are emotional concepts represented? Individually or by coordinate of features (valence, arousal)
- How is emotion encoded neurally? Where does emotion processing take place in the brain?
- How does emotion affect perception / object recognition?
- How does emotion affect reasoning?

Linguistic issues

- How is emotion communicated?
- Non-linguistically (Prosody, facial expressions, gestures) and linguistically (Lexically)
- (How) Are emotional aspects of meaning lexically encoded? - representation

Linguistic issues, cont

- Is the affect content of words processed differently from the non-affective(?) content?

  (Is this a coherent question, i.e., can you separate the two)

- Truth conditional vs. Non-truth conditional meaning
  - Frege’s rejection in Sense and Reference
  - Strawson’s (1950) « on referring »
  - Davidson’s (1986) « derangement of epitaphs »
  - Kaplan (then Kratzer) on « oops and ouch »
    —> Pott’s (2006) theory of expressives

A possible roadmap for today

1. The neuroscience of emotion

2. Linguistic issues in the study of affect

3.

Emotion in the brain

- **Limbic system**:
  emotional center of the brain

Amygdala
Hypothalamus

- **Autonomous nervous system**:
  neuronal pathways in the body that control organ functions (a type of motor system)

Periacqueductal gray

- **Frontal lobe**:
  Planning, decision making

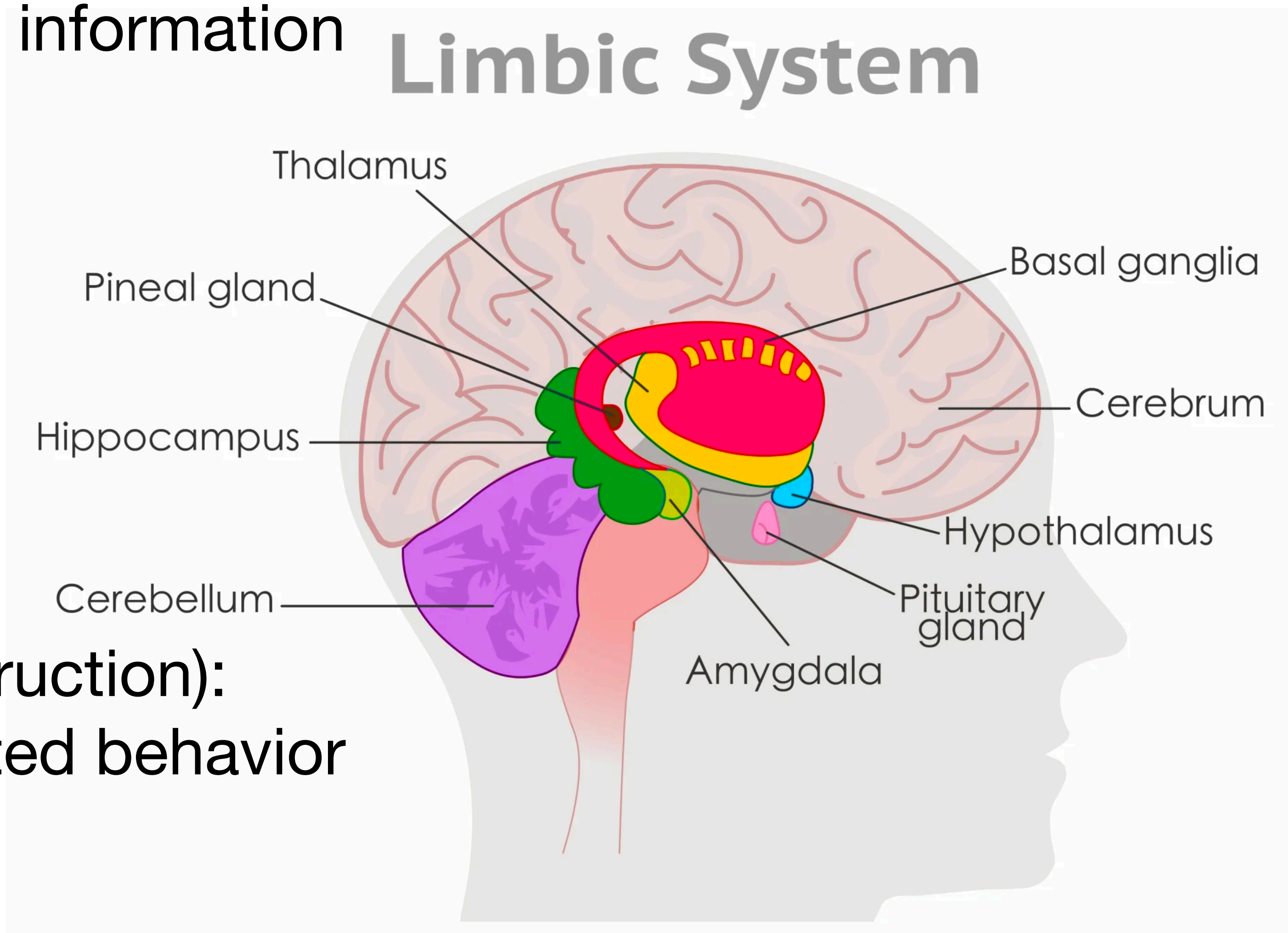
The limbic system

- **Thalamus**:
  sensory relay station; directs sensory information (except smell!!!!!)

- **Hippocampus**:
  converts STM to LTM

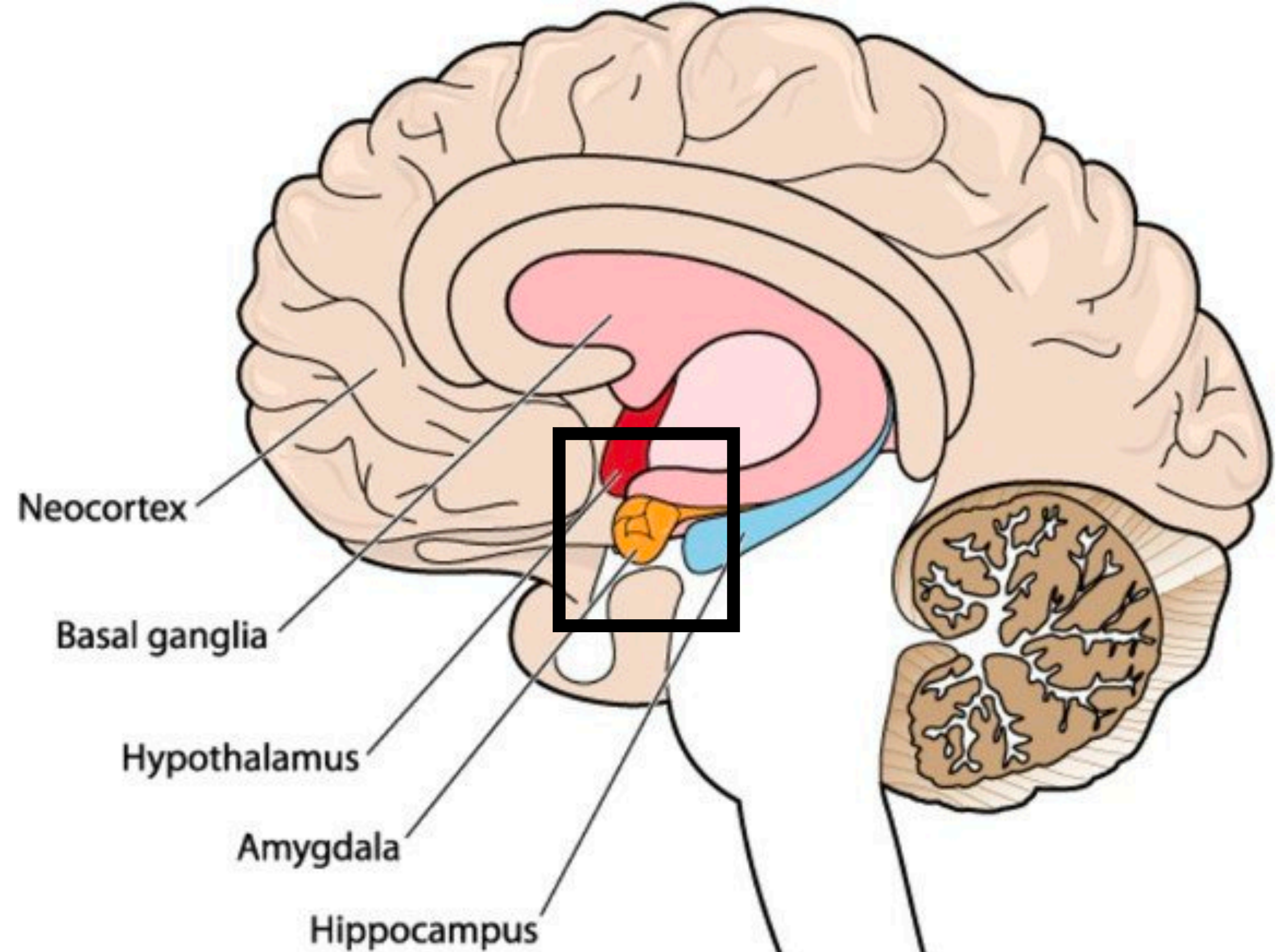
- **Amygdala**:
  fear & anxiety
  Kluver-Bucy syndrome (bilateral destruction): hyperorality, hypersexuality, disinhibited behavior (intoxication-like behavior)

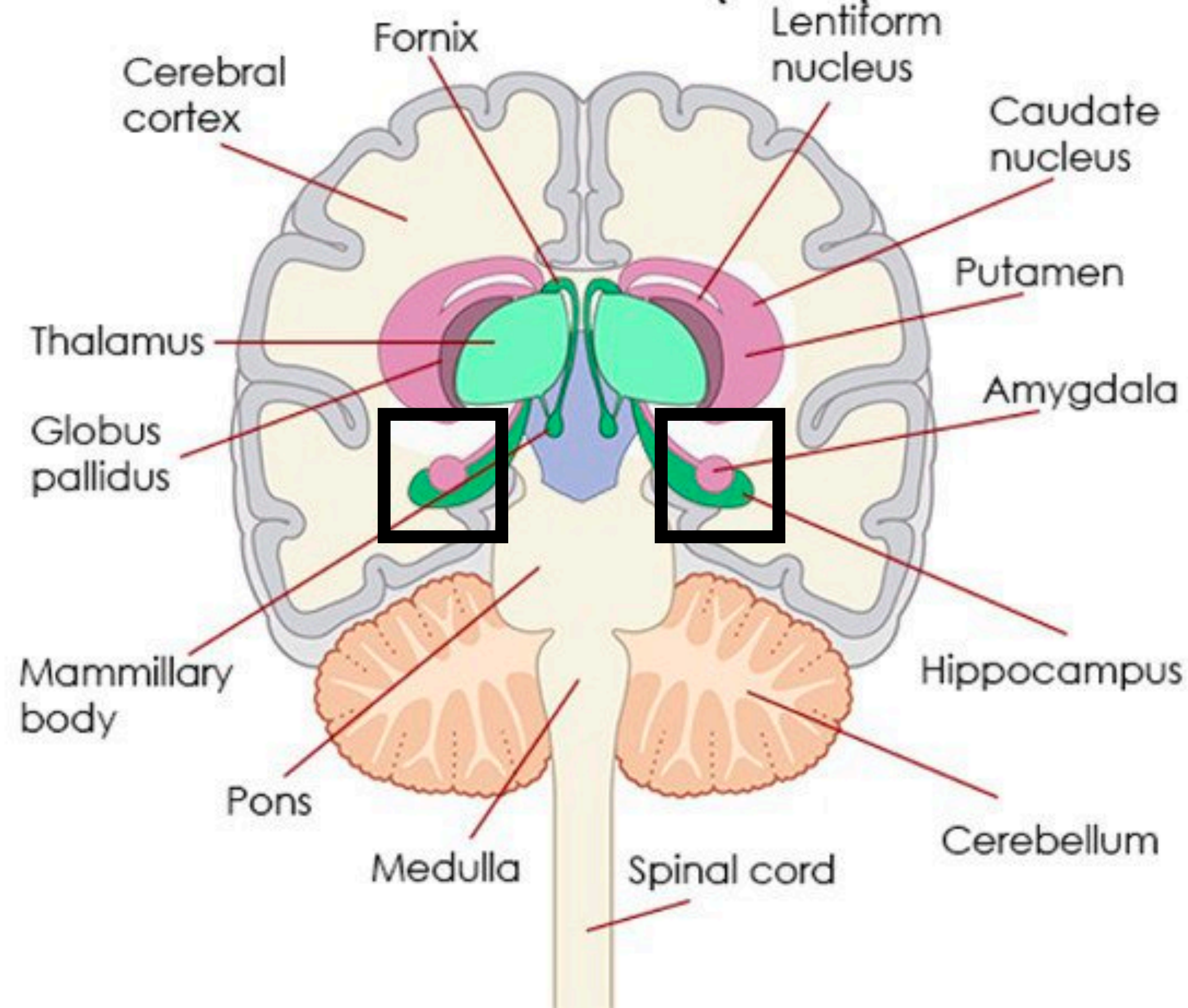
- **Hypothalamus**:
  regulates ANS; triggers the release of hormones ; hunger, thirst, sleep, sex



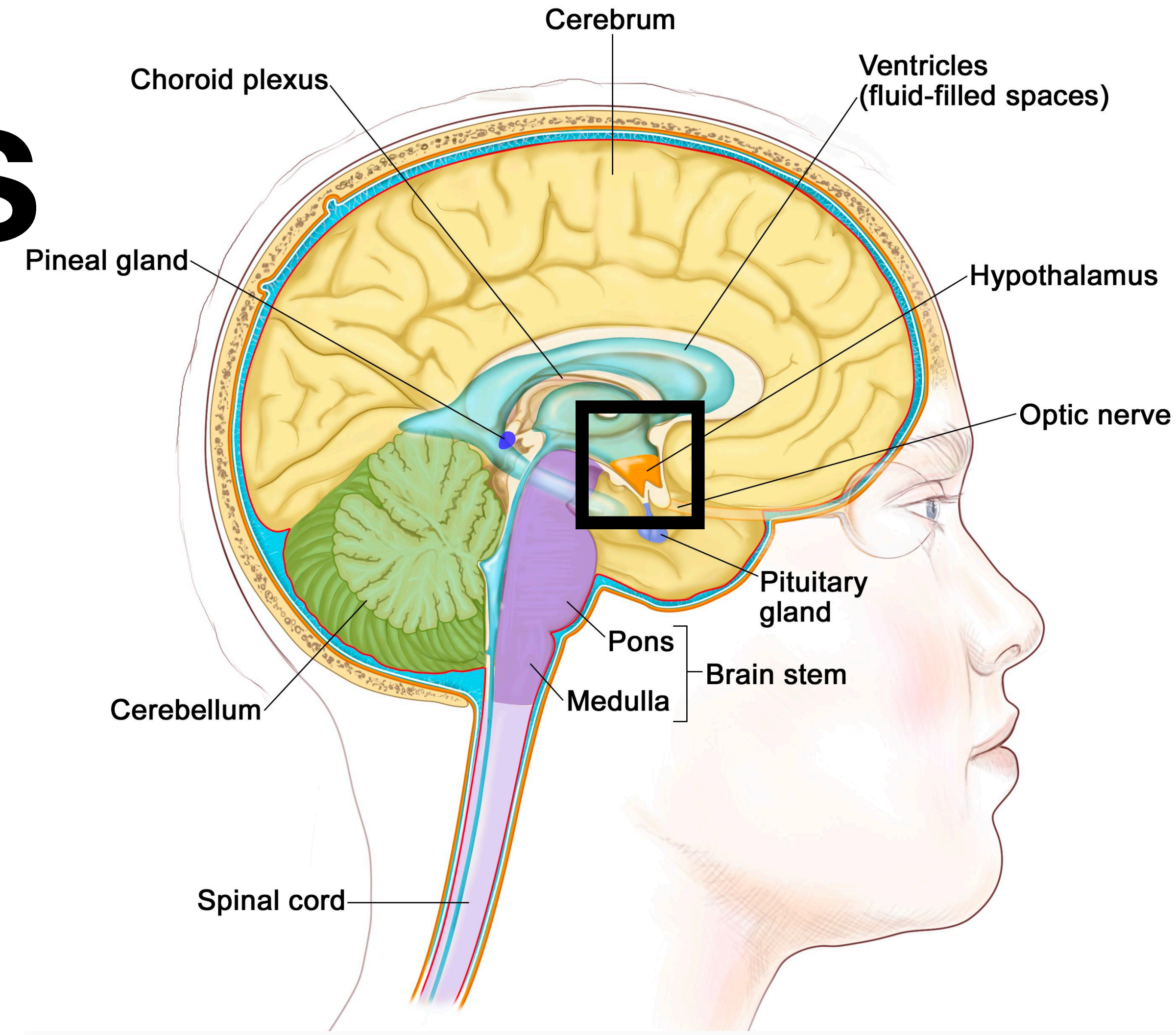
Amygdala

- Collection of nuclei in the temporal lobe, one in each hemisphere (almond shape)
- Fear & threat detection, But also positive stimuli
- Consolidation of memories with strong emotional components
- Emotional conditioning via long-term potentiation (vis Hebbian learning)



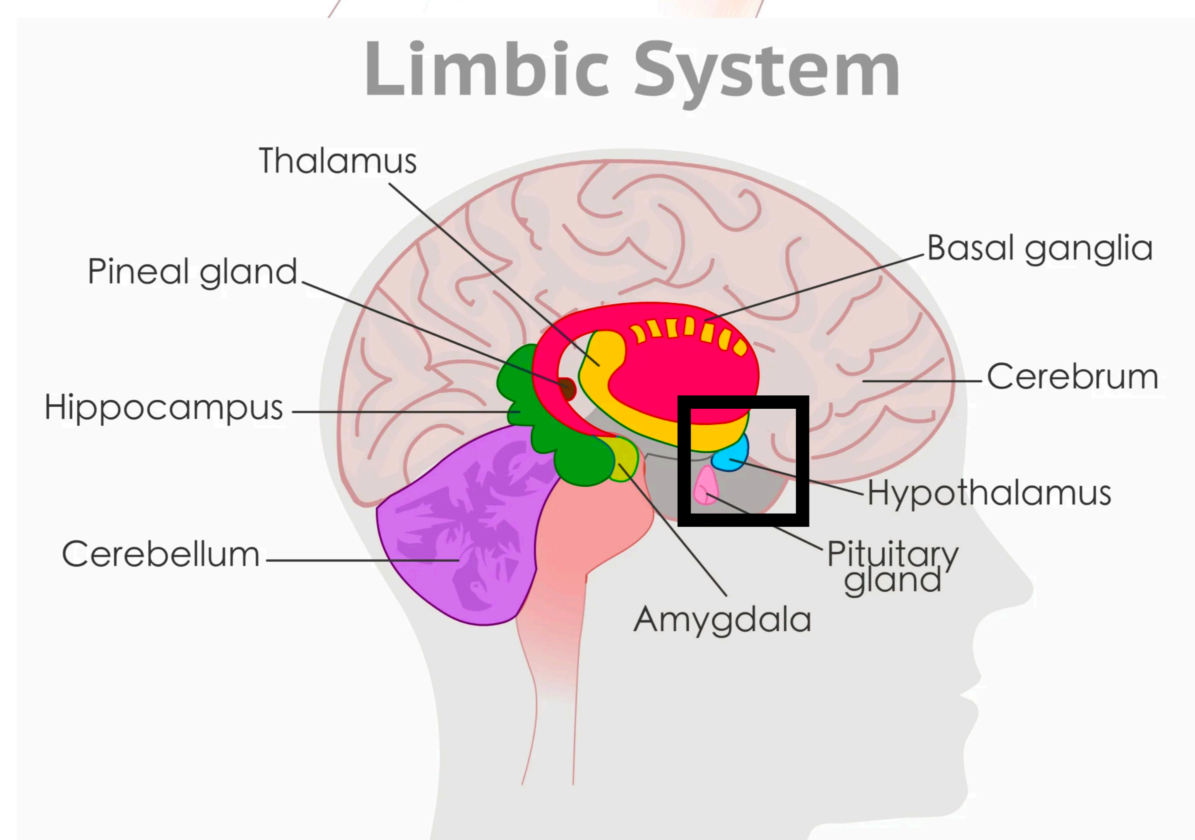


Hypothalamus



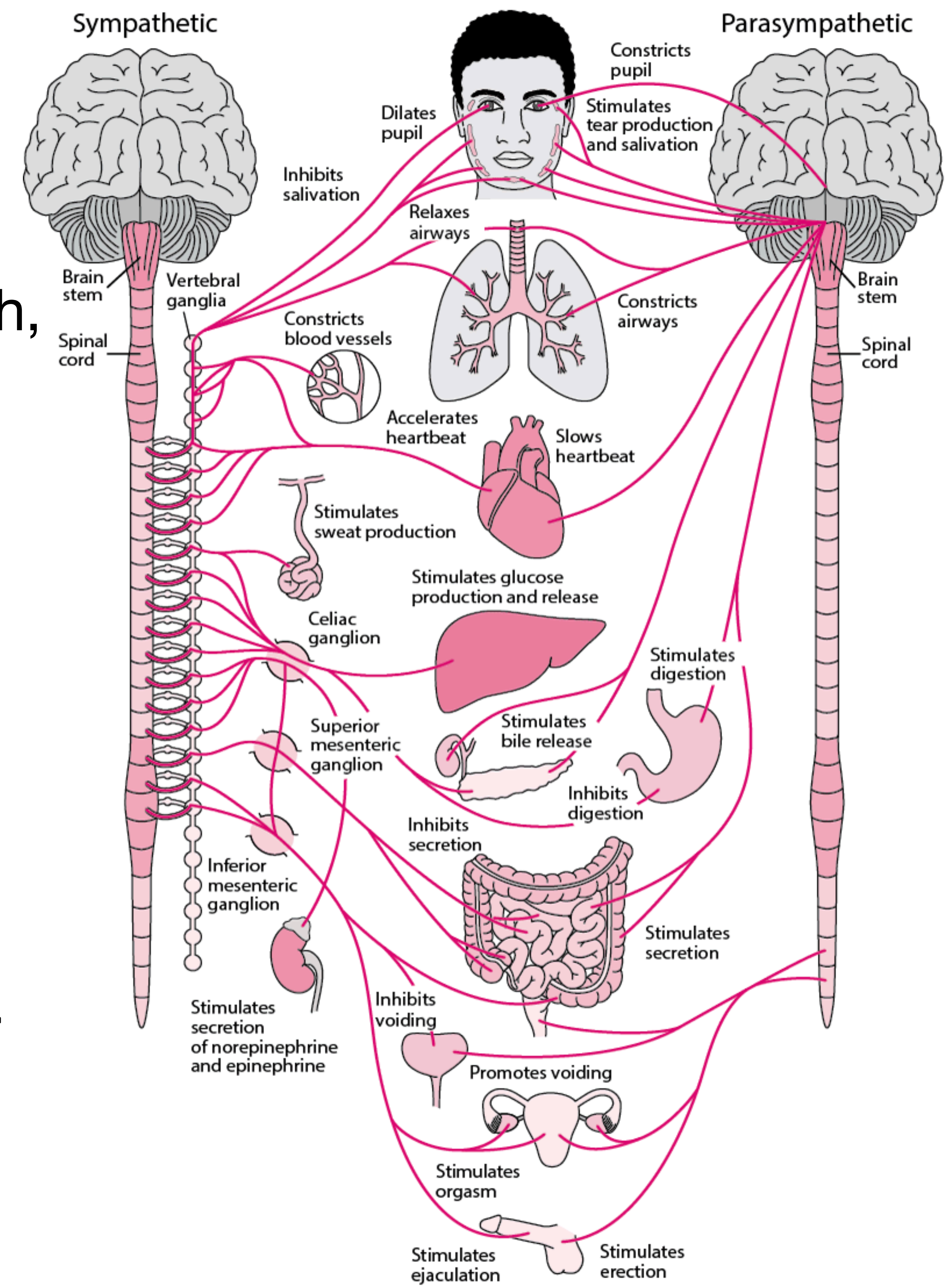
- Regulates endocrine system and autonomic nervous system, sleep/wake system

- Homeostasis (maintaining balance and stability) & hormones (thru pituitary gland)



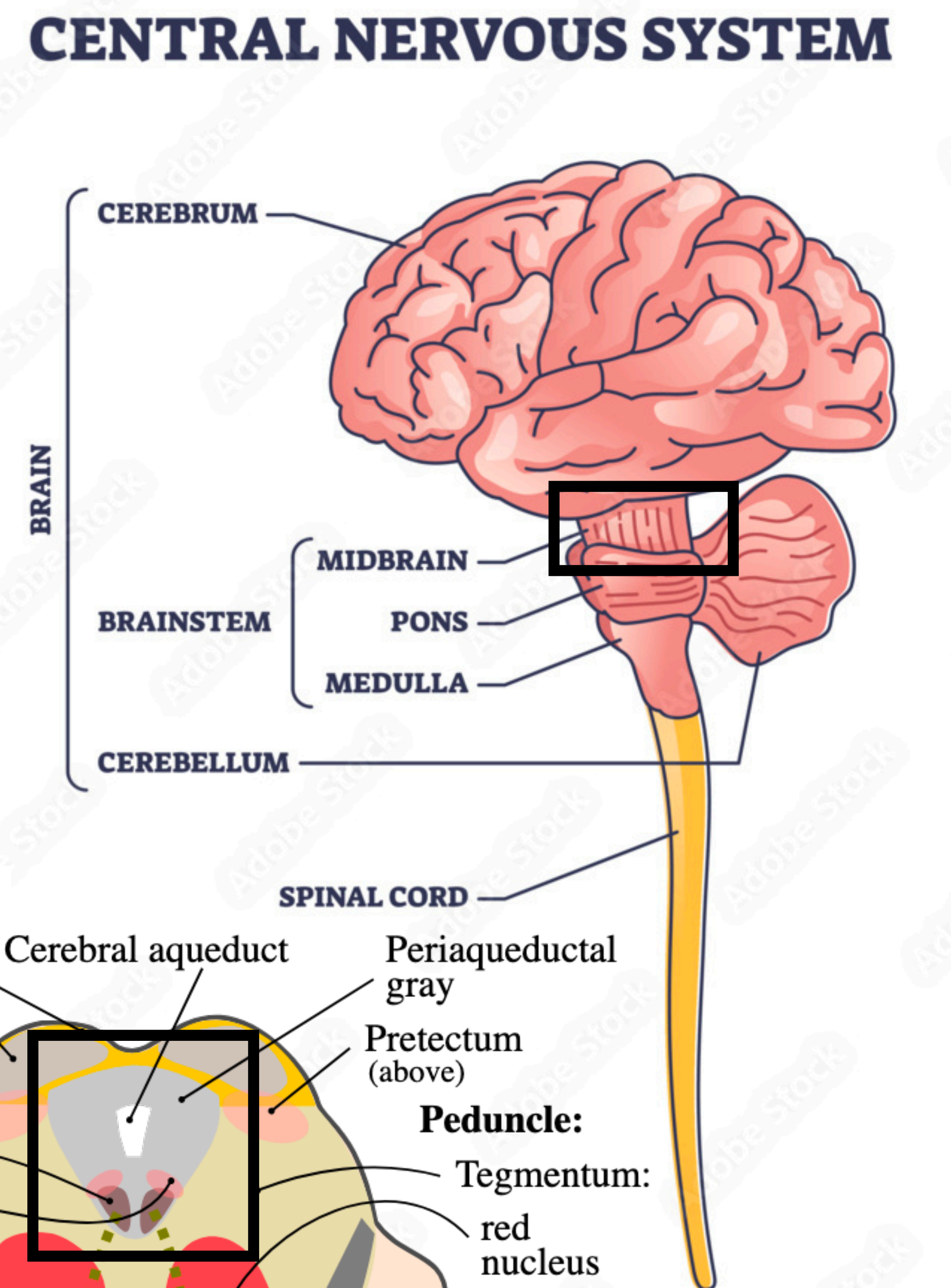
Autonomous nervous system

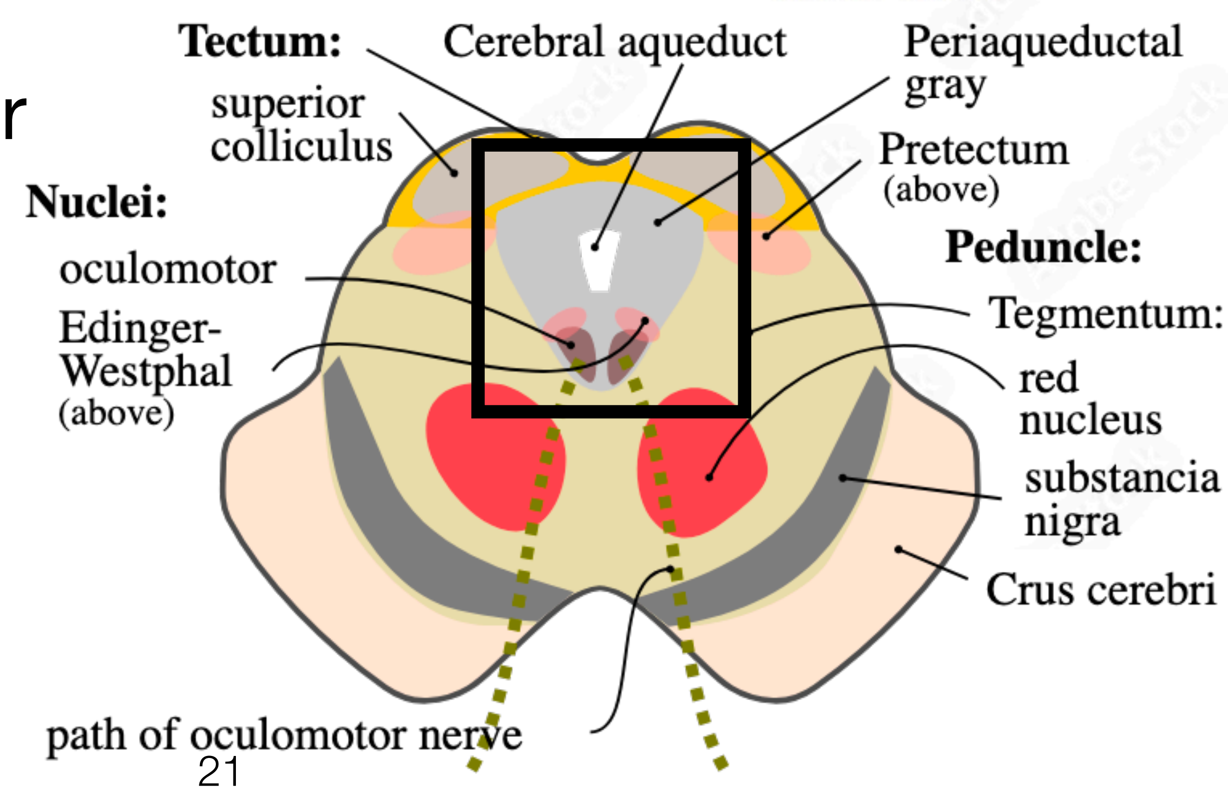
- Efferent neurons that control smooth, cardiac muscle, and gland cells
- Not conscious
- **Sympathetic** : « fight or flight » middle of the spinal chord neurons <u>short axon</u> that synapse to <u>nearby</u> ganglia to tissue
- **Parasympathetic** : « rest & digest » ends of the spinal cord, neurons w/ <u>long axons</u> that reach far ganglia to



Periacqueductal Gray (PAG)

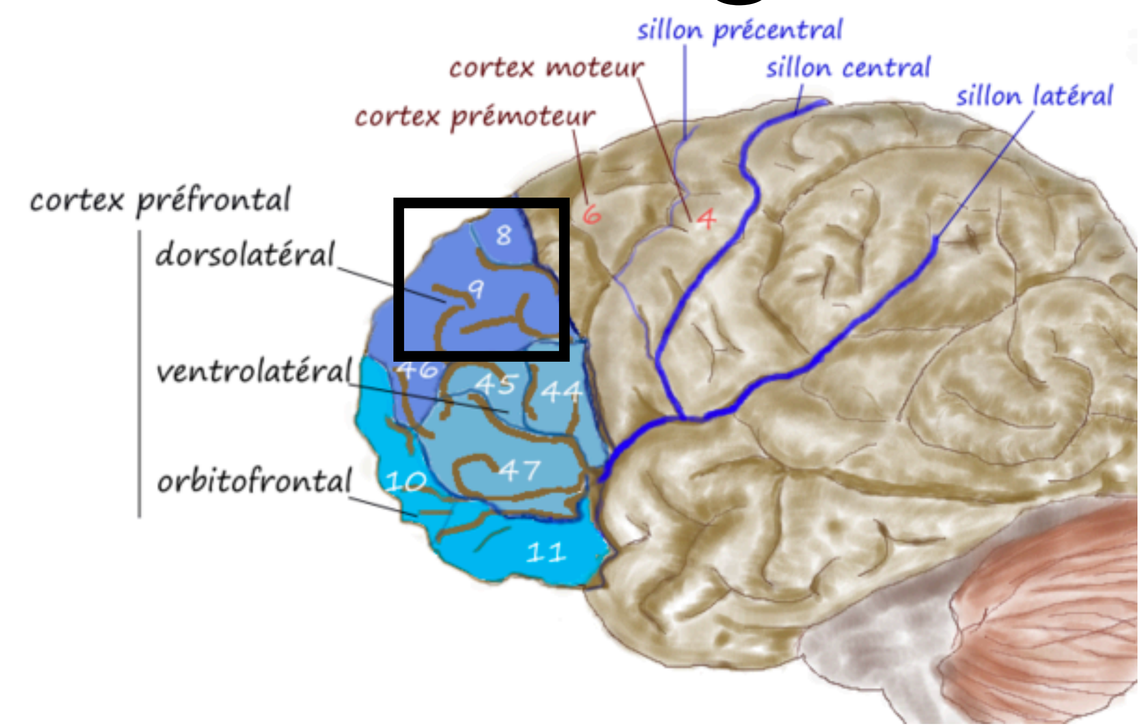
- Gray matter in midbrain consisting in neuron somas, surrounding the cerebral aqueduct
- Régulation of heart rate & blood pressure
- Autonomic processes (bladder control & contraction)
- Fearful & defensive reactions
- Analgesia (pain reduction)





Coactivation of the cerebral cortex - planning & decision making

Coactivation of cortex along with several of those systems as well! (Kober et al 2008)

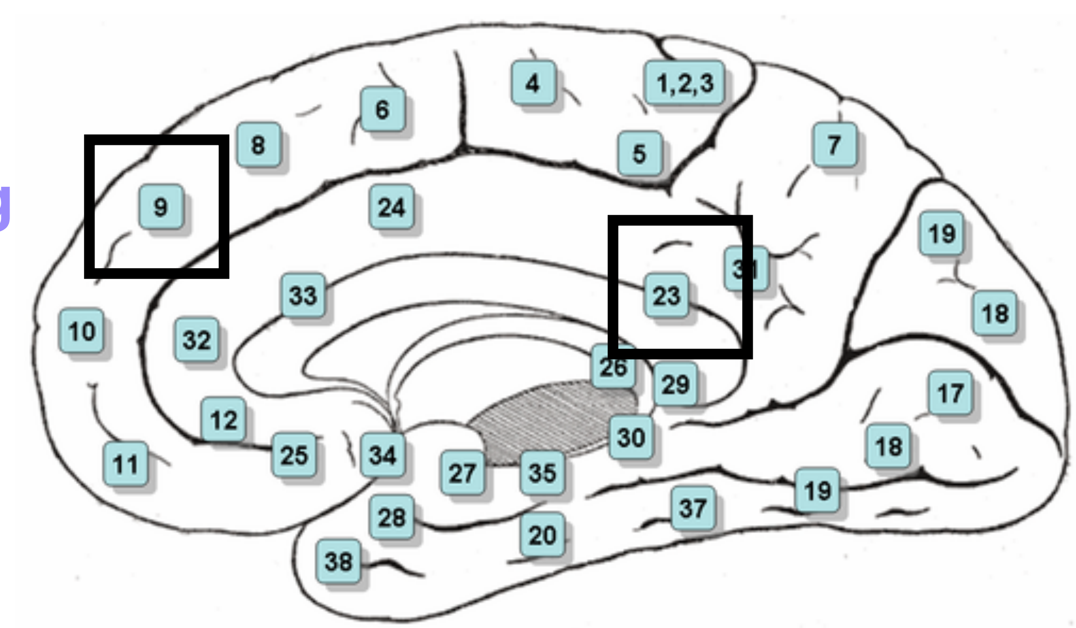


Medial/frontal closely associated with language production & comprehension (Broca's area), eye gaze, working memory, risk processing

- Amygdala + many areas of frontal cortex

Executive function, motor planning

- PAG/Hy + Brodmann's Area 9 (dorsolateral prefrontal cortex) and Brodmann's Area 23 (posterior cingulate cortex)



Upper limbic system! episodic memory retrieval

Korber et al (2008) found 6 functional groups of consistent co-activations wrt emotion processing:

A: Lateral Occipital/Visual association
B: Medial Posterior group
C: Cognitive/Motor Group
D: Lateral Paralimbic group
E: Medial PFC Group
F: Core Limbic group

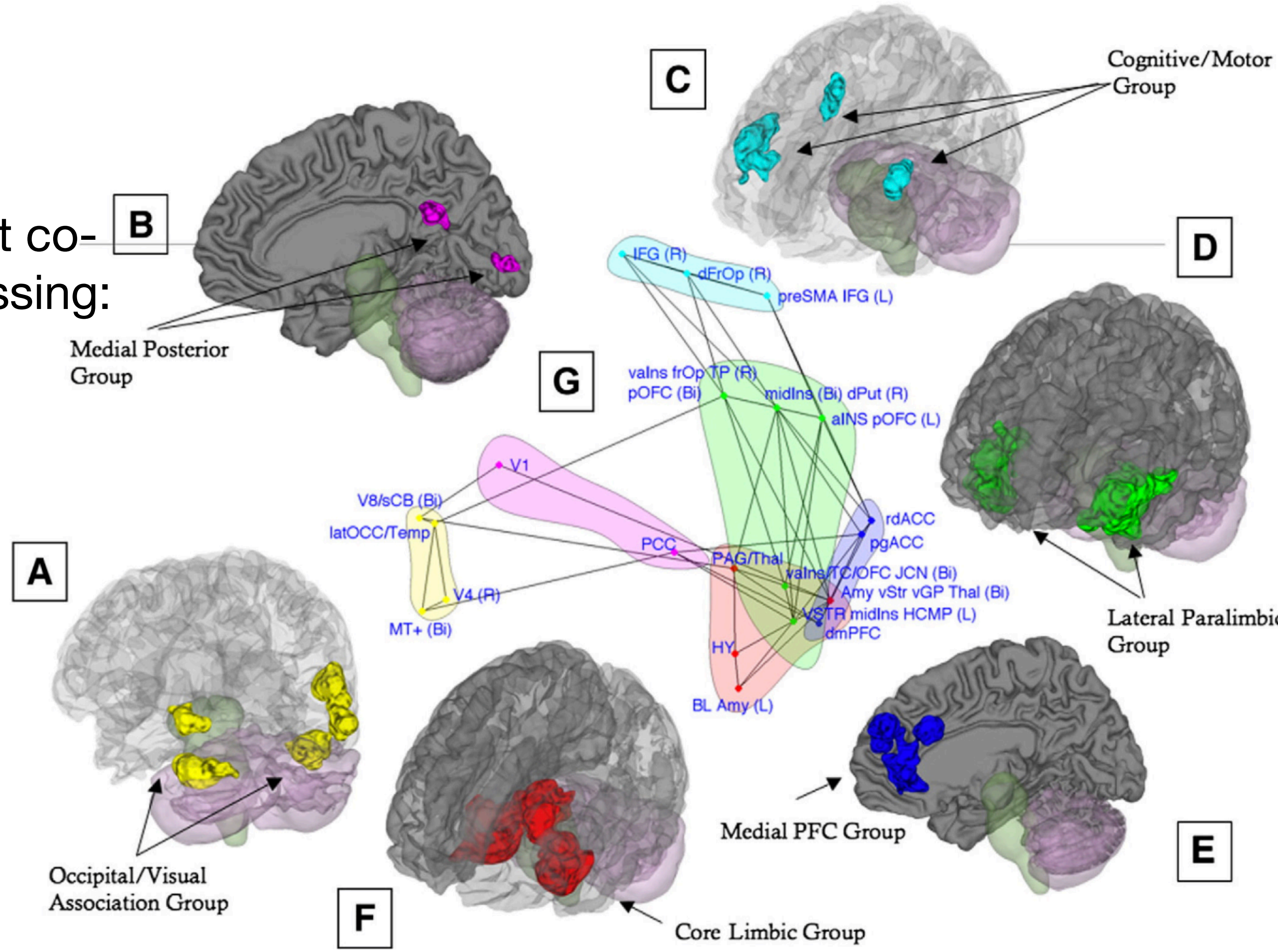


Fig. 7.

(A–F) The six functional groups revealed by our multivariate analysis are depicted in 3D rendering on the single-subject brain. Regions in each group are rendered in a unique color. (G) To visualize the relationships among the regions in each group, both regions and co-activation lines are displayed on a "flattened" map of the connectivity space along the first two dimensions determined by NMDS (see Methods). Colors correspond to those in panels A–F and identify each network. Points closer together on the graph tend to have stronger positive co-activation, and connected lines represent significant Tau-b (τ) association values between pairs of regions. The connectivity map has been "pruned" such that the relationships depicted are direct, meaning that they were not completely mediated by any other single intervening region. Direct relationships were assessed by mediation analyses considering each possible mediating region in turn, with 1000 bootstrap samples per analysis. See Table 1 for abbreviations

Methods in neuroscience (briefly)

- EEG
- MEG
- fMRI
- PET
- TCM

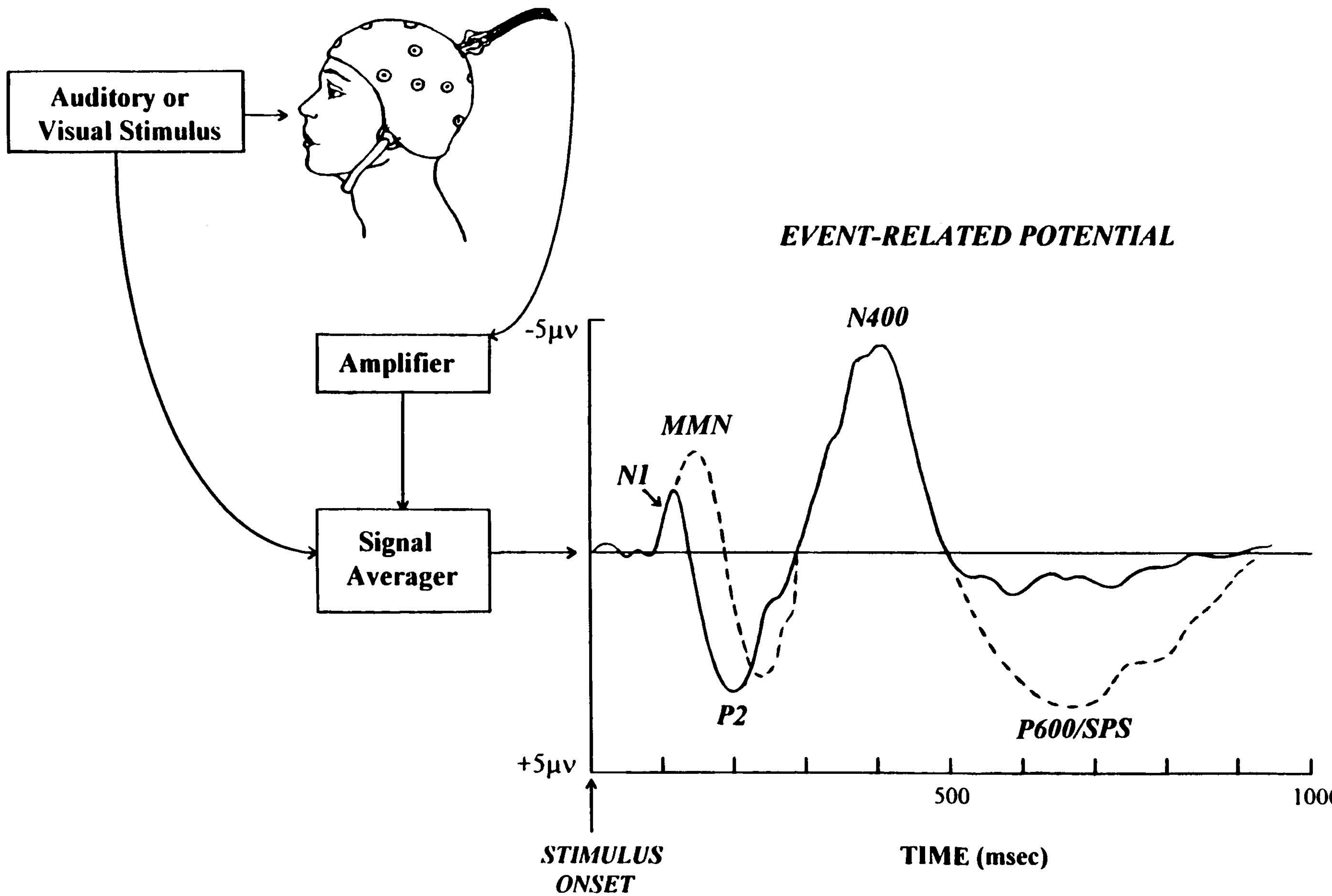
- Electro/magnetic (EEG, MEG) vs. hemodynamic (fMRI, PET)
- Trade-off between temporal vs. spatial resolution

Neuroscientific method	Parameters measured with this method	Temporal resolution (accuracy in time)	Spatial resolution (accuracy of locating active brain areas)	Pros for design studies	Cons for design studies
fMRI (functional magnetic resonance imaging)	BOLD-signal (blood-oxygenation-level-dependent signal), changes in blood flow after increased neuronal activity	Block design studies: several seconds to minutes Event-related studies: hundreds of milliseconds	From several millimeters to sub-millimeter accuracy	Some fMRI study protocols are quite well suited for design studies	Equipment cannot be removed from the laboratory; sequence of activities is difficult to study
EEG (electro-encephalo-graphy)	Electric potentials from scalp, directly resulting from neuronal activity	Less than a millisecond	Problematic due to distortion of electric potentials, less than 1 cm in good conditions	Portable instruments, natural environments, some EEG study protocols are quite well suited for design studies, long tradition of well-controlled experiments, measurements of several hours are practically possible	Location of brain activity is difficult to determine
MEG (magneto-encephalo-graphy)	Magnetic fields outside the head, directly resulting from neuronal activity	Less than a millisecond	Less problematic than EEG, in good conditions clearly less than 1 cm	Some MEG study protocols are quite well suited for design studies, long tradition of well-controlled experiments stemming from EEG, optimal time-space-resolution	Equipment cannot be removed from the laboratory; location of brain activity is quite difficult to determine
MRI (magnetic resonance imaging)	Structures of the brain (structural MRI), neural tracts (DTI, diffusion tensor imaging)	no accuracy in time	Less than 1 mm	Good for studies comparing groups of people	Equipment cannot be removed from the laboratory
PET (positron emission tomography)	Structural image of concentration of metabolically active tracer, usually oxygen	Contrast of two conditions: no accuracy in time	Less than 1 cm	Good for comparing groups of people or natural tasks	Radioactive tracer is injected into participants; equipment cannot be removed from the laboratory
NIRS (near-infra-red spectroscopy)	Diffusion and absorption of near-infra-red light in tissues, depending on hemodynamic and electromagnetic changes in brain tissue	hemodynamic NIRS: hundreds of milliseconds, electromagneti c NIRS: millisecond (according to some researchers)	Theoretically less than 1 cm	Portable instruments, natural environments, some NIRS study protocols are quite well suited for design studies, measurements of several hours are practically possible	Difficulties in determining the location of brain activity, not many groups yet using NIRS for cognitive studies

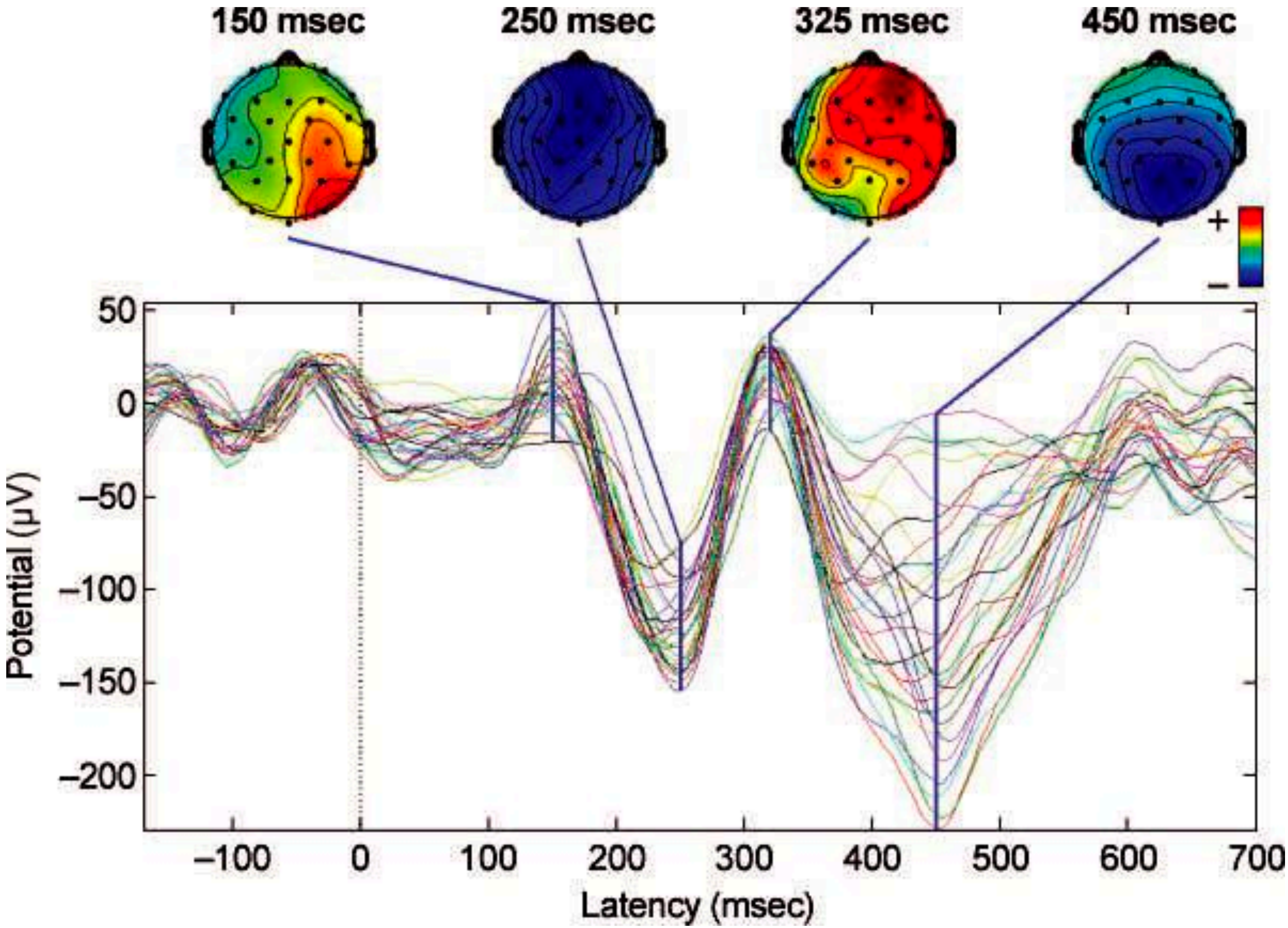
Event-Related Potential (ERP)

- EEG recordings post stimulus (=event)
- Participants presented with a stimulus, and the electrical activity is measured

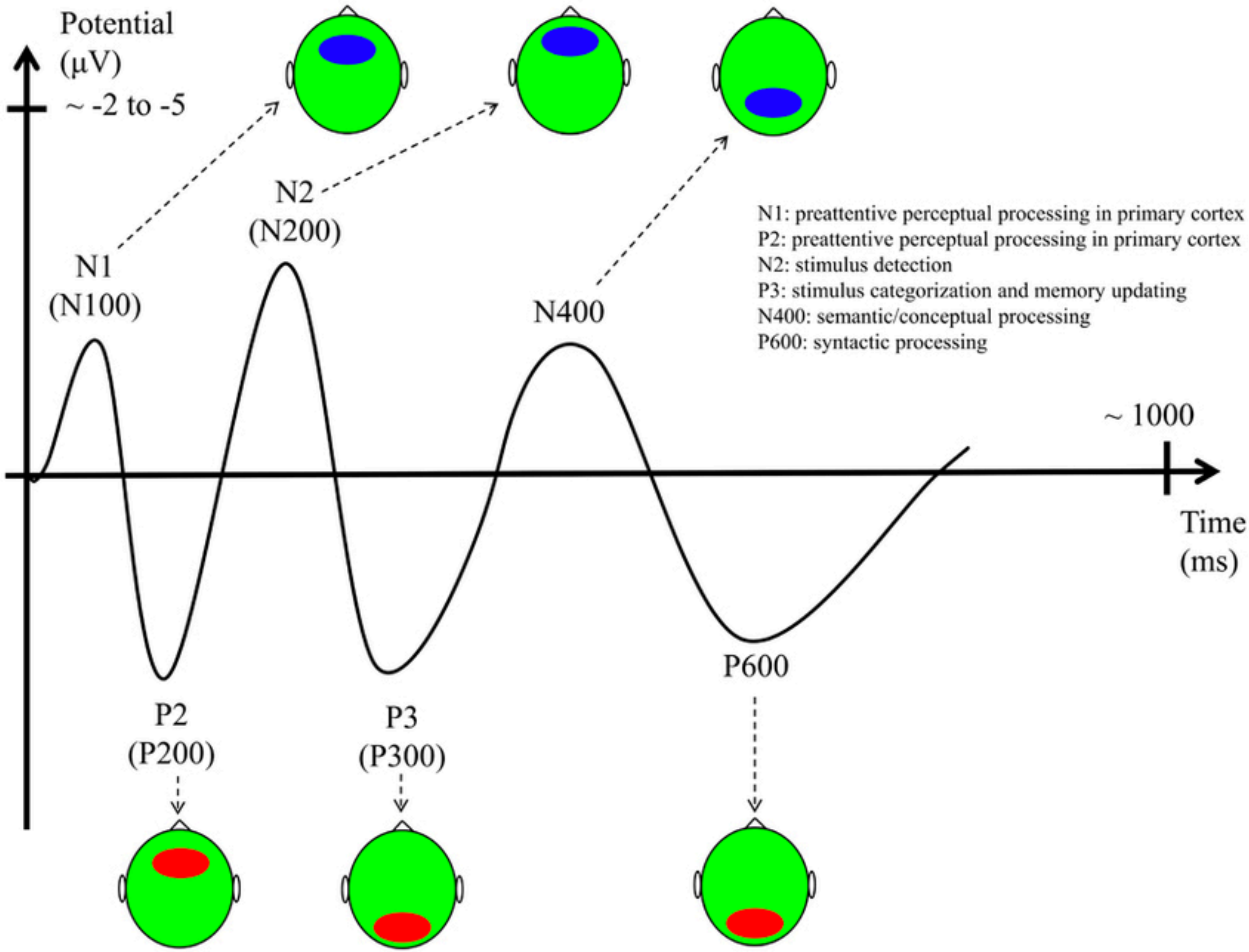
ERP



Auditory or Visual Stimulus
Amplifier
Signal Averager
EVENT-RELATED POTENTIAL
-5μv
+5μv
N400
MMN
N1
P2
P600/SPS
500
1000
STIMULUS ONSET
TIME (msec)



Holcomb & Grainger 2006

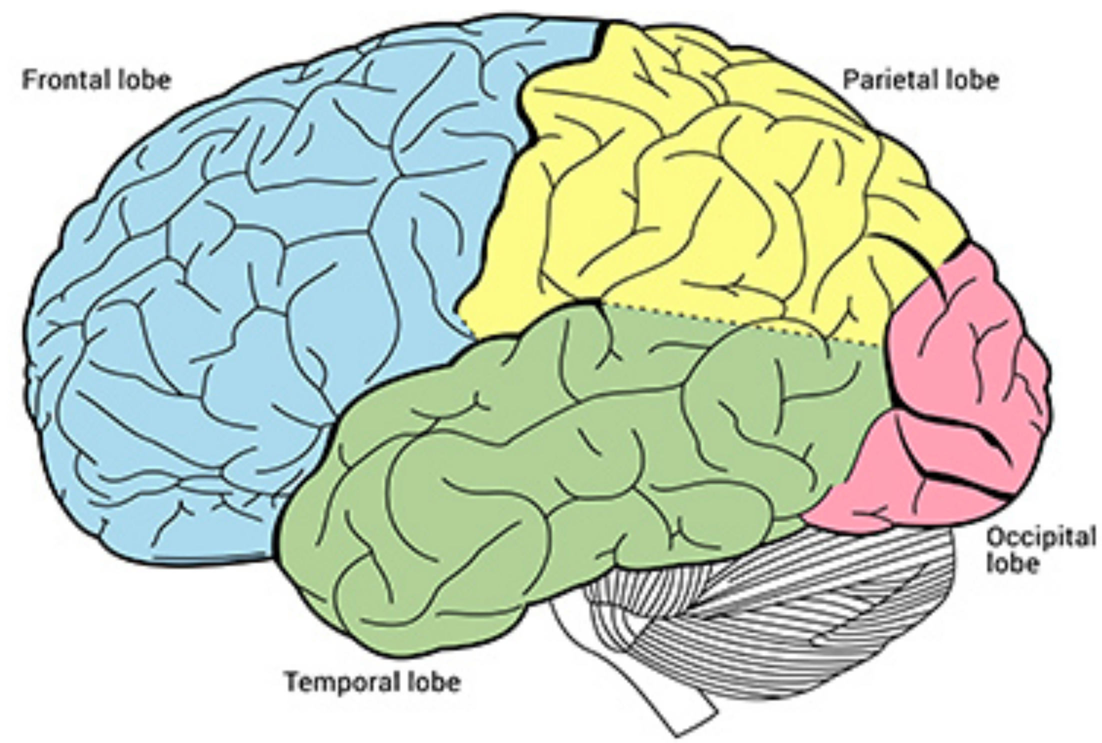


Daltrazzo & Conway (2014)

Early ERP signatures of Information processing

Processing of low-level visual (and auditory) information of the stimulus

- **P1** (~80-100ms), occipital positivity
- **N1** (~120-170ms), occipito-temporal negativity



P1 / N1 & Emotional words

Mixed results: modulation by word frequency, age of acquisition, target relevance, stimulus type (neg vs neutral yes, emo vs color no)

Inferences from Topography:

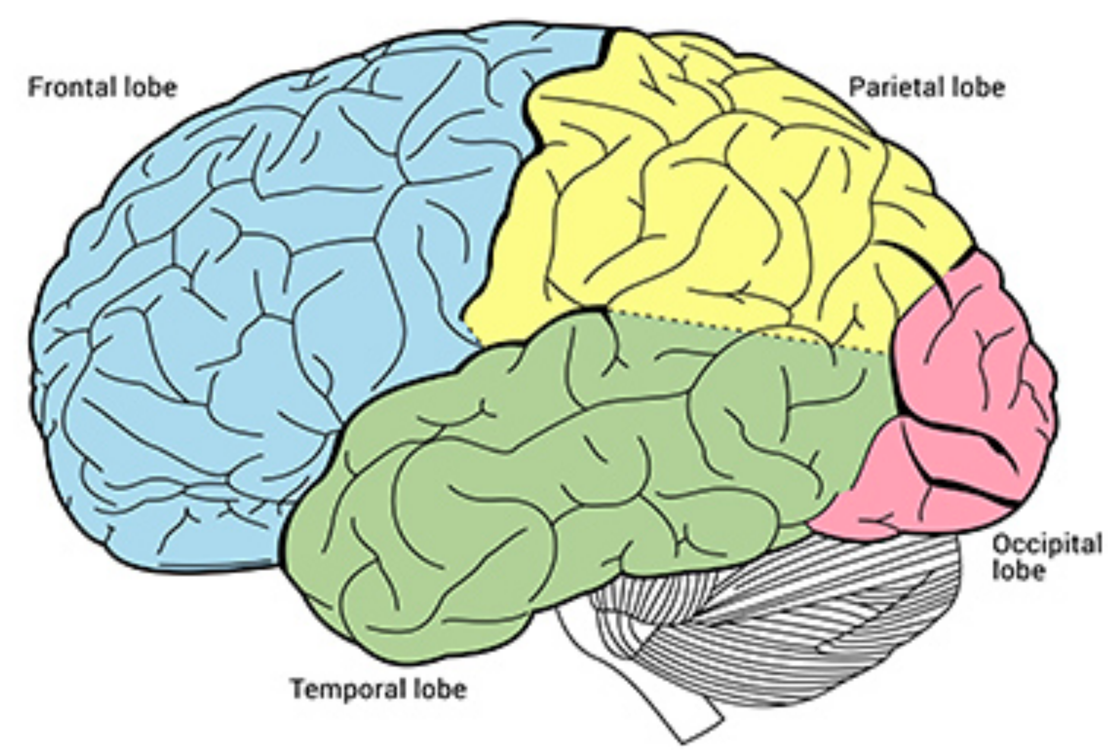
- Bilateral occipital cortices:
  Associational learning (mnemonic) mechanisms

- Left occipito-temporal (middle temporal gyrus, fusiform gyrus)
  Speeded lexical access/semantic activation

Mid ERP signatures of Information processing

- **P2** (~200ms), variable topographic distribution
  - Anterior: exogenous (stimulus driven, passive) attention, word repetition

- **EPN** (~200-300ms), occipital-temporal negativity



EPN

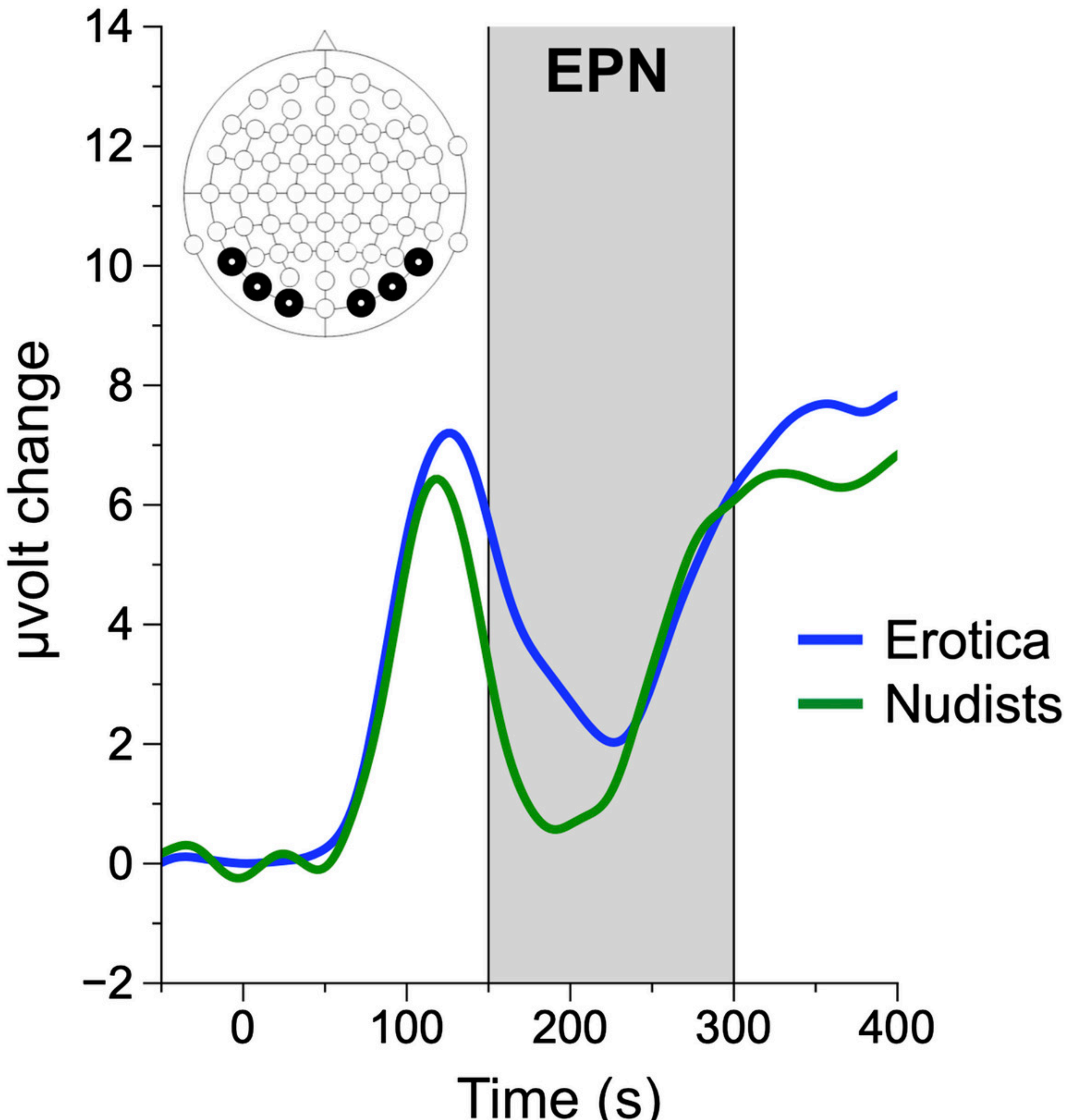
- Larger amplitude for emo (+,-) than neutral words

- Lexico-semantic processing

- Automatic, task-independent attention allocation to intrinsically relevant emotional features of words

- Driven by arousal

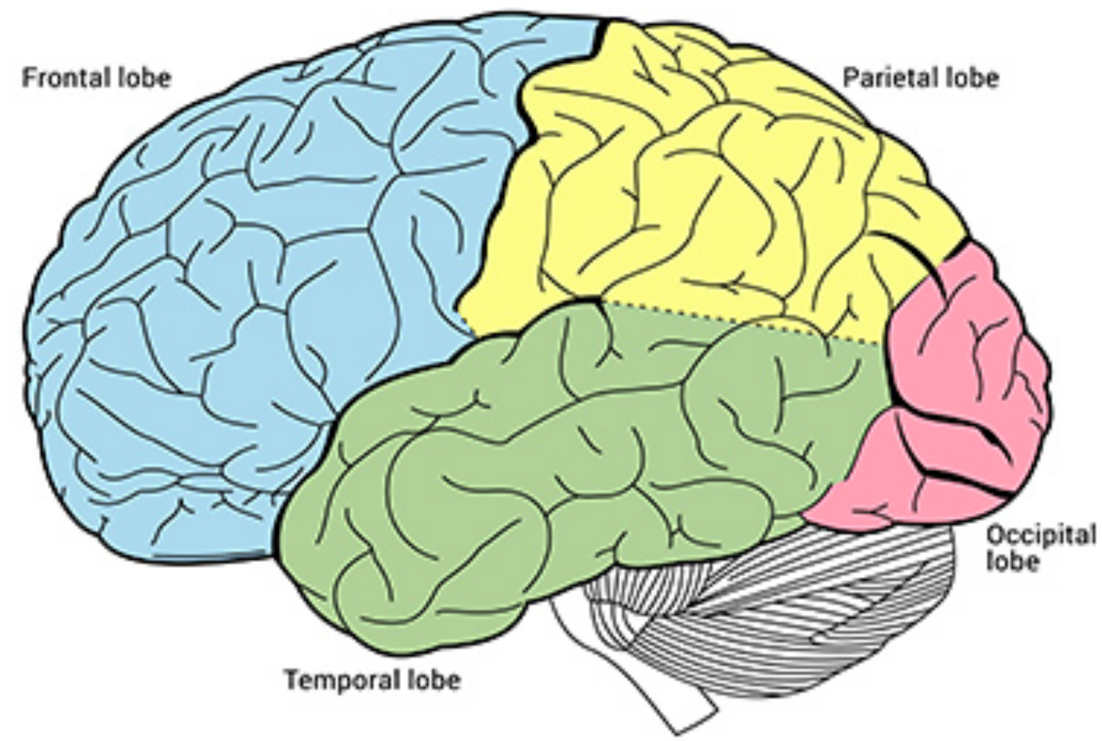
Farkas, Oliver, Sabatinelli 2019



Late ERP signatures of Information processing

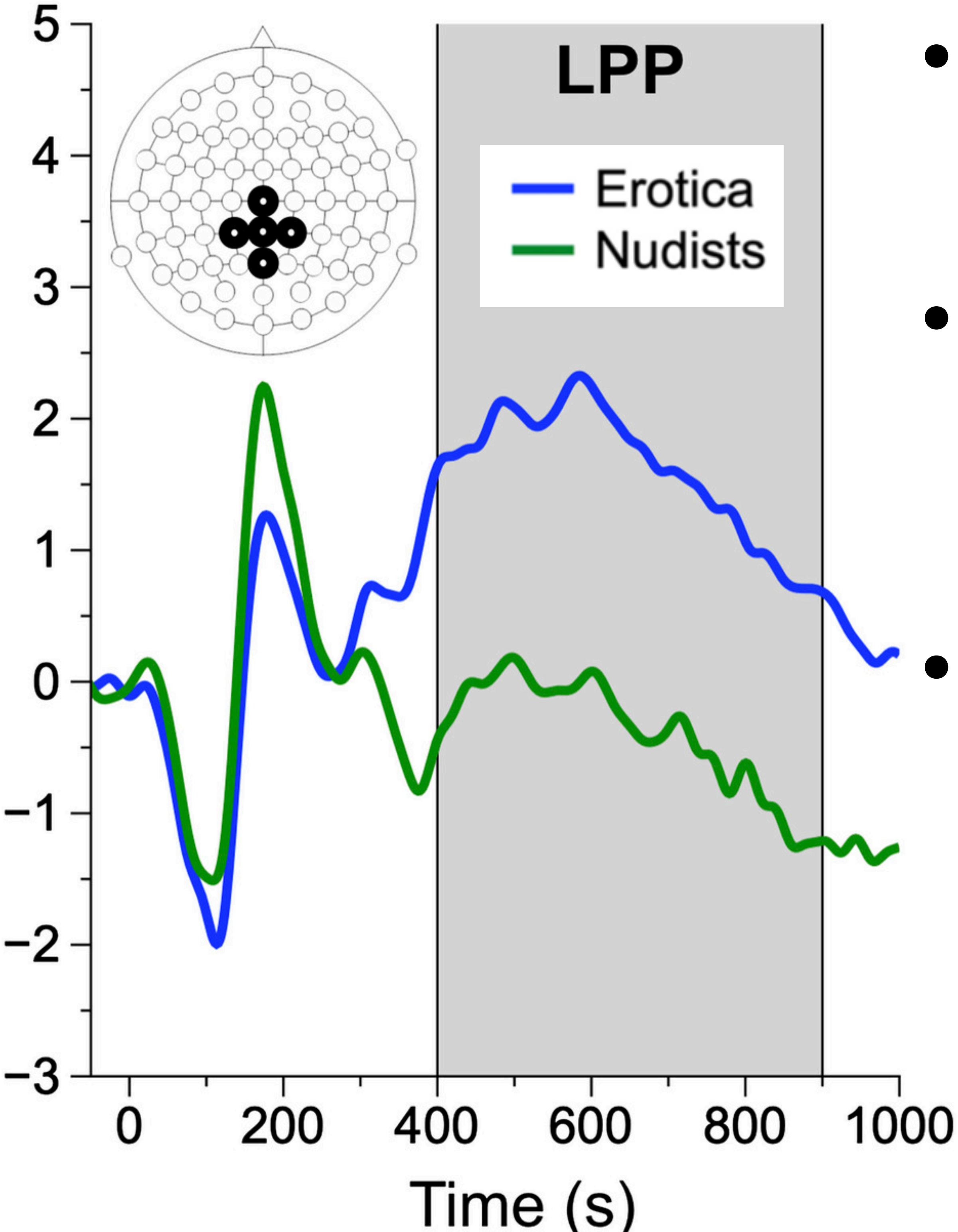
Late Positive Complex/ Potential (LPC/P) :
family of positivities emerging from 400ms on,

Centro-parietal topography



LPC

Farkas, Oliver, Sabatinelli 2019



- Evaluation and controlled attention; Semantic processing
- Différences btw pos and neg words, maybe arousal to blame (approach/withdrawl systems)
- *modulated by stimulus type and task*
  effects observed if task requires lexical processing, but vanish if structural task

Afterthought: N400

Centro-parietal negativity peaking ~400ms

N400 effets congruent vs incongruent (difficulty processing)

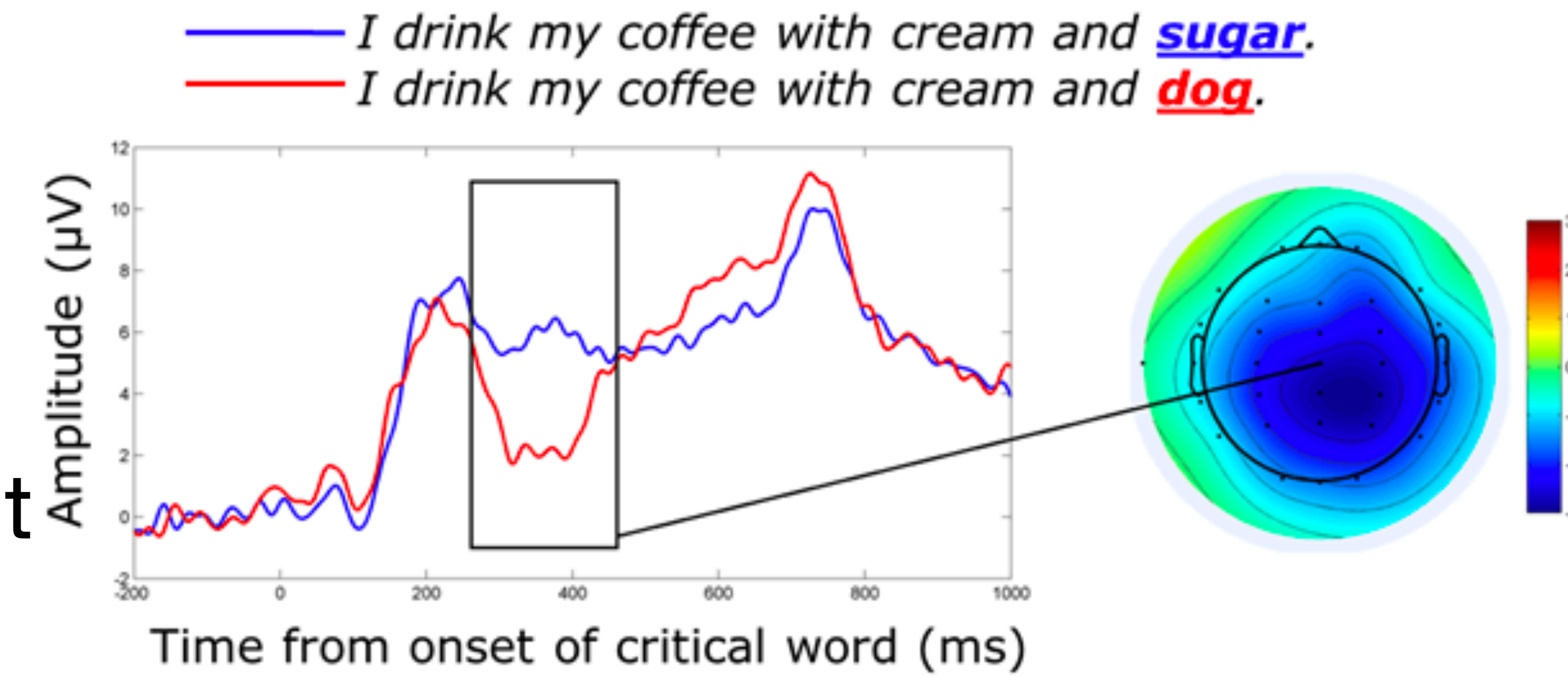


Figure adapted from Hunt, Politzer-Ahles, Gibson, Minai, & Fiorentino (2013)

- Emo words elicit *smaller* N400 than neural words
- Emo features facilitates semantic and post-lexical processing
- Consistent with fMRI/PET: lexicon-semantic and affective evaluation brain activated

Aside: ERP signatures of **WORD** processing

N170: (150-200 ms)

- enhanced with words compared to pseudo words
- Identification of graphemes (word forms)
- Automatic visual categorization
- No lexical or frequency effects

Summmary

- No strong evidence for early (pre-lexical) effects of emotion in written word tasks!

- Emotion does not drive early visual object learning **in words** -
highly symbolique, opaque meaning/form connection

- Emotion processing really begins at the lexicon-semantic processing stage (EPN)

TASK EFFECTS!

- Crucially! The task can affect the response
- Task serves to direct attention:
emotion effects observed when the task directs attention to the emotional component of the stimulus, at both early and late stages

Interacting variables

- **Word frequency**
- Word length
- Native/non-native
- Gender differences
- Morphosyntax
- **Concreteness**
- Imageability
- Age of acquisition
- Familiarity
- Contextual availability
- Semantic relatedness

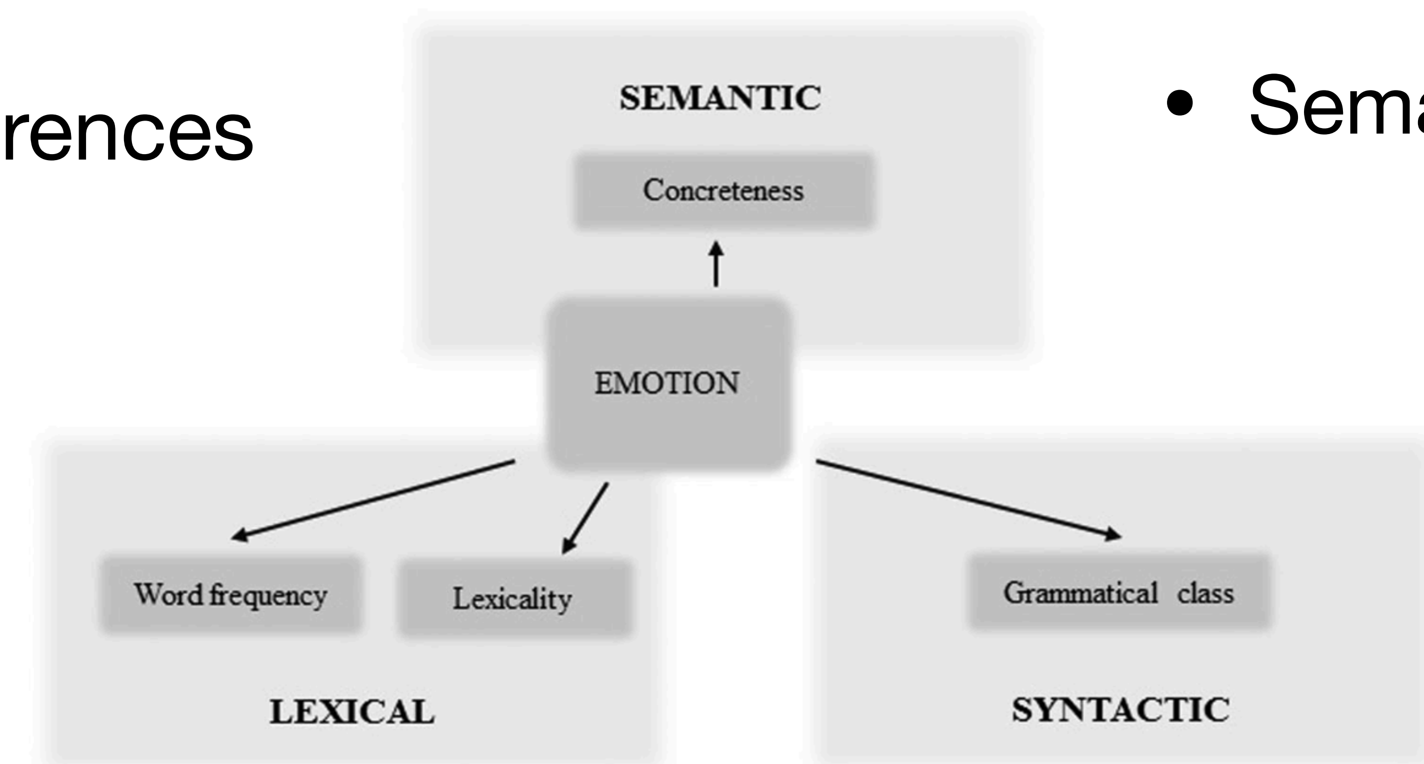


Figure 2. Relations between emotional features and different lexical, semantic and syntactic features at the word level.

Hinojosa, Moreno & Ferré (2019)

Frequency

- Larger emo effects in LF than HF words
- Both fMRI and behavioral responses
- In ERP, across the multiple latencies (LF amplified in later especially)
- Interactions with other variables…

Concreteness

- It seems that larger emotion effects in abstract vs concrete words (….)
- ERP & RT effets modulated by task (again!), but :
  EPN enhanced for concrete emo (Palazova et al)
  LPC (mental imagery, Kanske & Kotz 2007)
- Emotion effects found in semantic judgement tasks (hinojosa et al 2014, Kaltwasser et al 2013, concreteness effects when focus is on lexical tasks

The challenge of abstract concepts

- Abstract concepts are not observeable in the way concrete ones are

- Statistically, it seems abstract concepts are more valanced than concrete ones

- Asymmetry in processing and acquisition of abstract versus concrete concepts:
  - concrete processed faster, acquired earlier than abstract

Are abstract concepts emotionally grounded?

- Vigniocco et al (2009): abstract words have a lack of experimental grounding therefore emotion (and language) is what grounds abstract concepts
  (Kousta et al 2011, Meteyard et al 2012, Crutch et al 2013, igliocco et al 2014; and for acq arguments Costa et al 2011; Ponari et al 2018; Ferré et al 2015)

- actually the idea goes back to Aristotle, Galen (humours), Spinoza, Descartes…William James

- Motor Theory of Perception:
  Emotion words seem to activate limbic and premotor cortex (Mosley et al 2012, Dreyer & Pulvermuller 2018)

Embodied cognition

- Cognition is grounded in the sensory-motor systems
- Motor theory of speech perception
  (Alvin Liberman in the 50s-60s)
-

Winter (2022)

- Yes, in general abstract concepts are rated more strongly positive/negative In Croatian, Durth, French, German, Indonesian, Italian, Polish, Spanish (not Cantonese or Mandarin)

- Caveat: it only holds when you use a particular concreteness rating measure and statistical analyses matter, otherwise the pattern reverses!

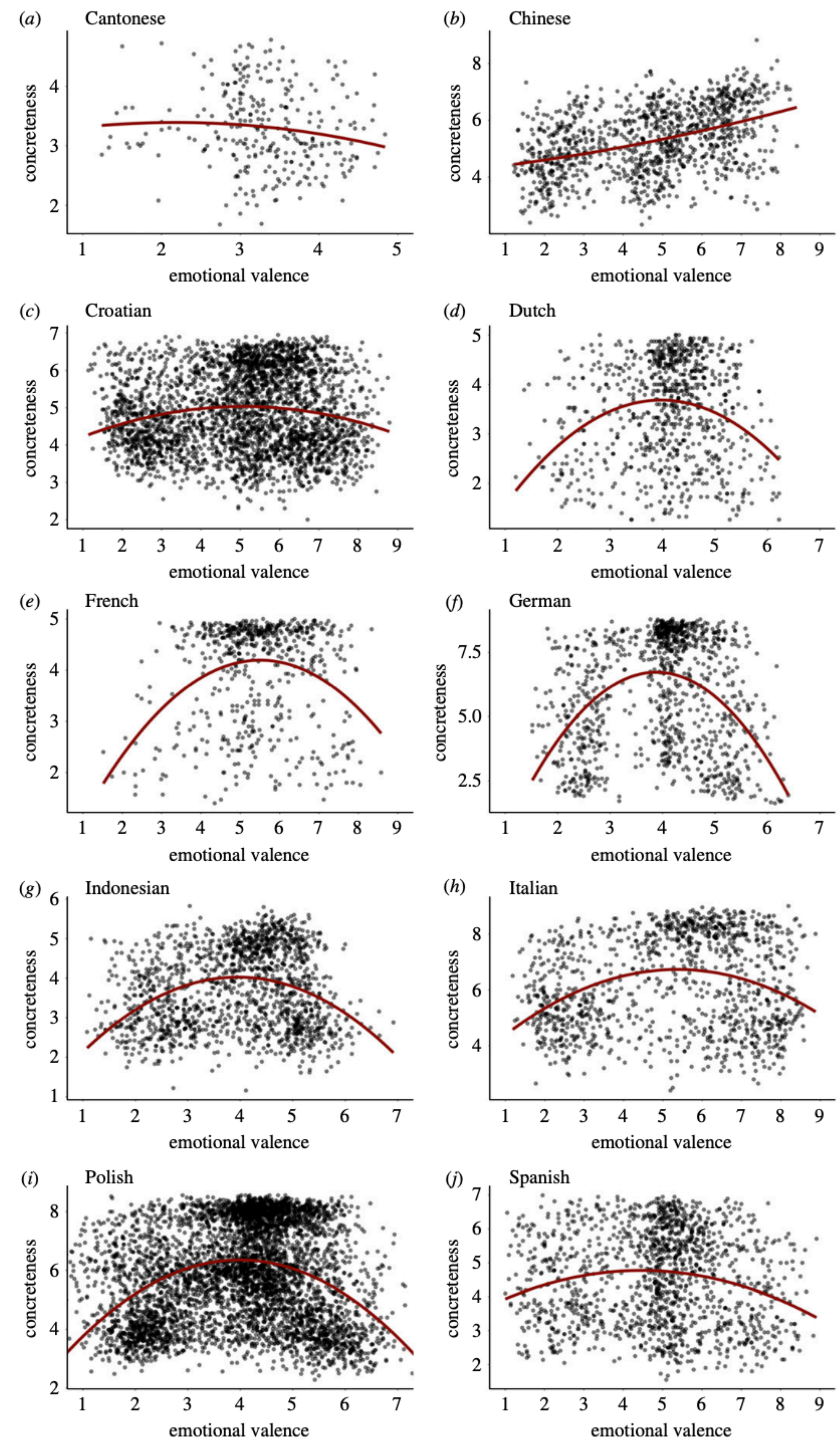


Figure 1. Scatter plots of all words in concreteness × emotional valence space for the respective languages, with super-imposed linear regression fits. (Online version in colour.)

Too simplistic?

- I hate racism vs I love racism

  (-) + (-) = (+)   (+) + (-) = (-)

Positive vs negative

- Maybe difference between positive versus negative valence
- Different neural systems