Neurofeedback training:
Theory and emerging perspectives on new treatment methods

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History

- 1928 – Hans Berger "EEG – window on the mind"

First EEG measurements by Berger around 1928.

Recognized importance of quantification and objectivity in the evaluation of EEG

Theorized abnormalities in the EEG would reflect clinical disorders

Example of EEG recordings by Berger
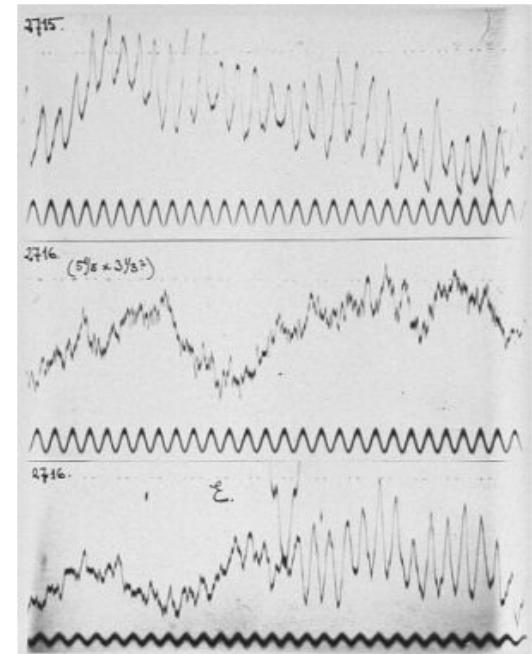
History

- ## 1963 – Joseph Kamiya and alpha training

"Anxiety Change Through
Electroencephalographic Alpha
Feedback Seen Only in High Anxiety
Subjects"

James V. Hardt and Joe Kamiya
Science, Vol. 201, pp. 79-81, 7 July 1978

- Recognition of certain brainwave states - alpha

- Self regulated production of alpha

- Demonstated typical biofeedbackloop – a twoway process
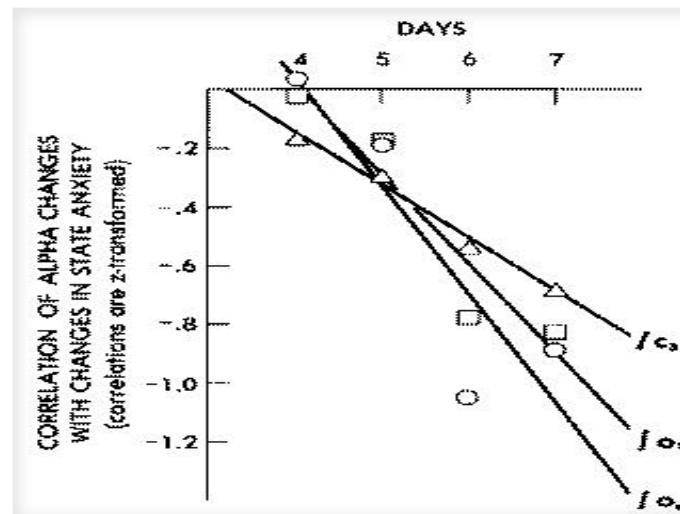
History

- 70s – Barry Sterman and sensorymotorrhythm (SMR training)

"Neurofeedback treatment of epilepsy: from basic rationale to practical application."

**Tobias Egner & M Barry Sterman. Expert Rev. Neurotherapeutics 6(2), 247-257, 2005)**

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Neurofeedback

EEG signal

EEG Amplifier → Computer Screen → Loud-speaker

Animation and sound feedback
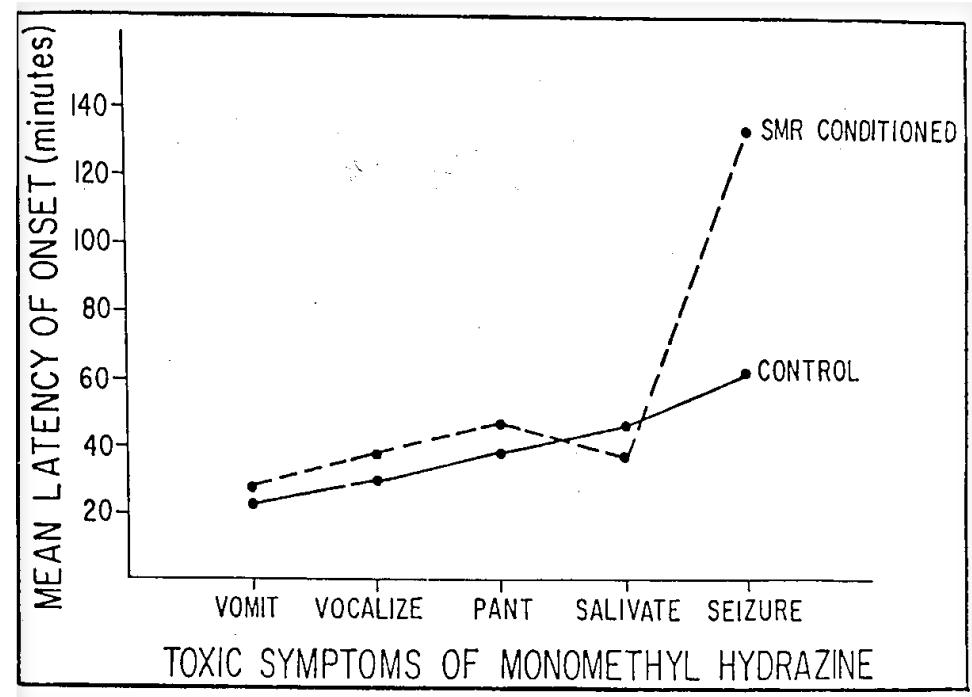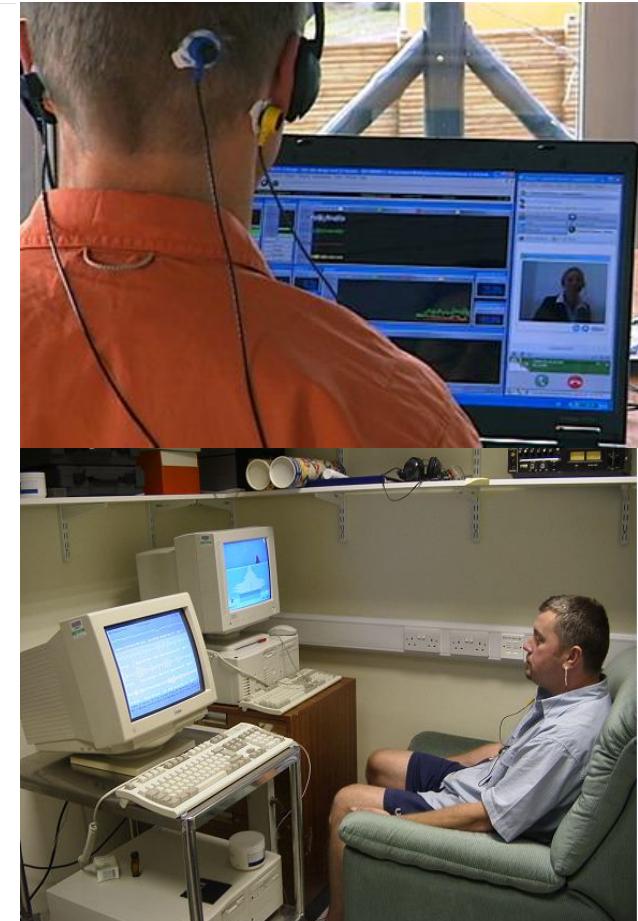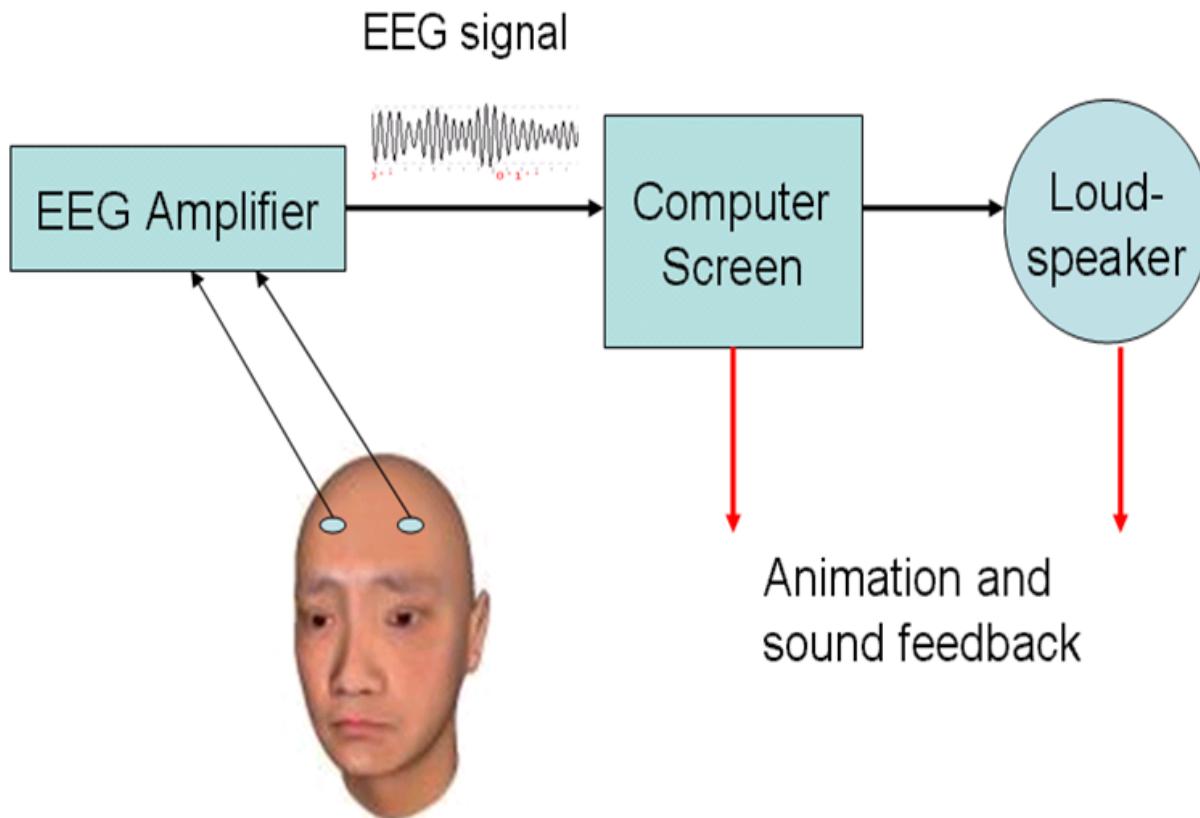
Today – brain network changes in mental disorders
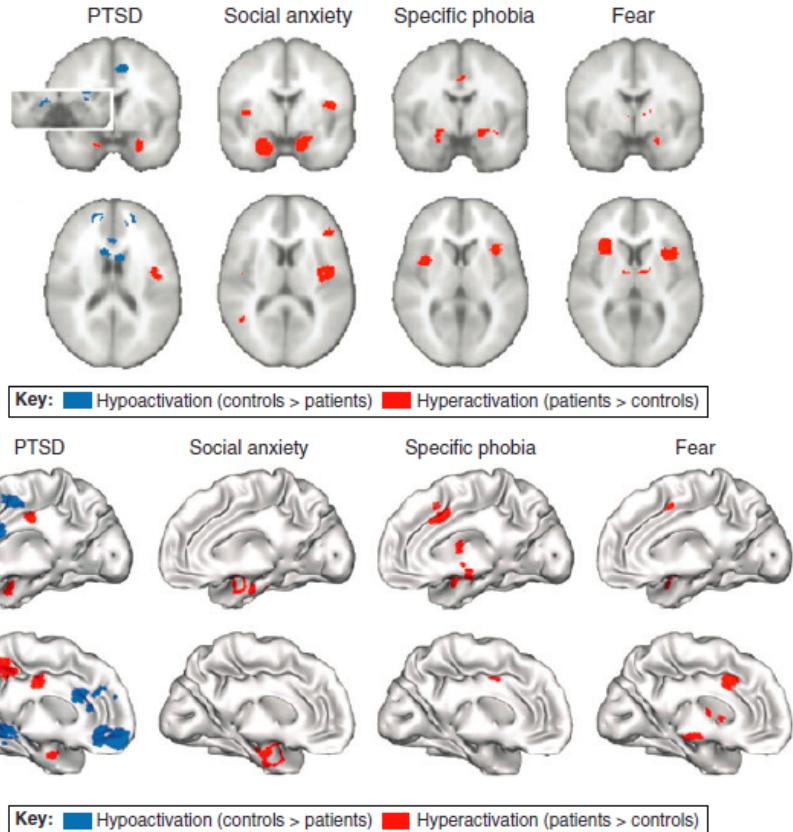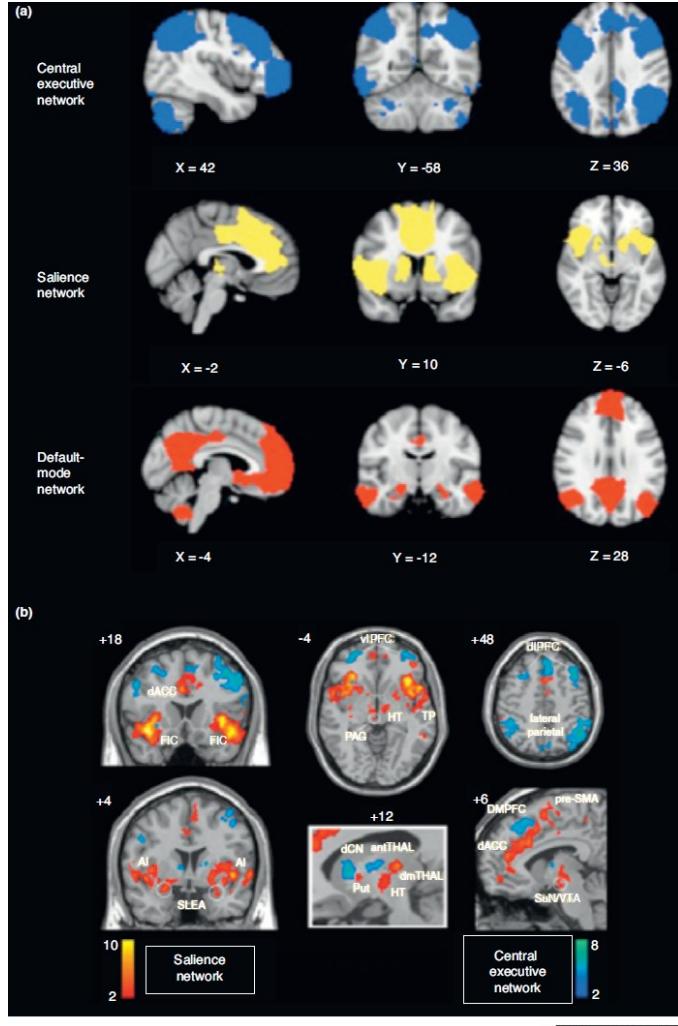
fMRI


$500,000 - $3 millions
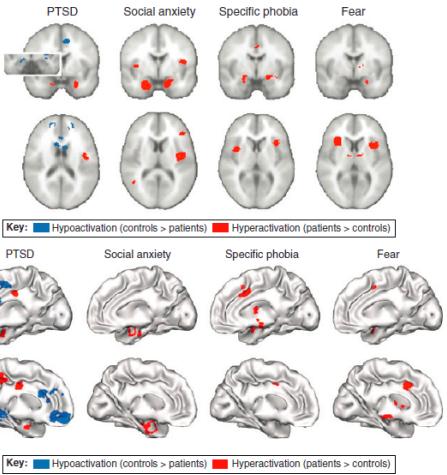
$500,000 to $3 million
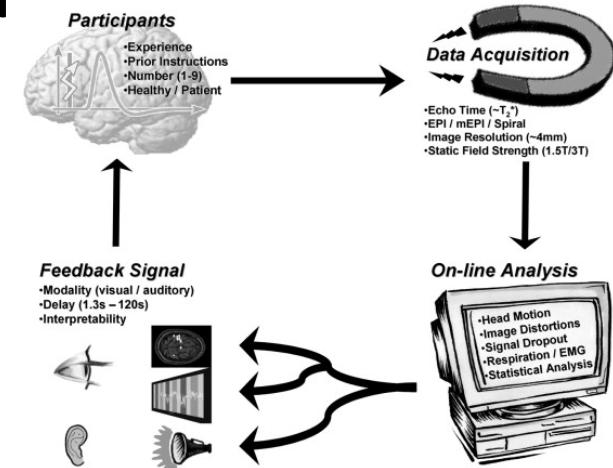
$10,000 to $20,000
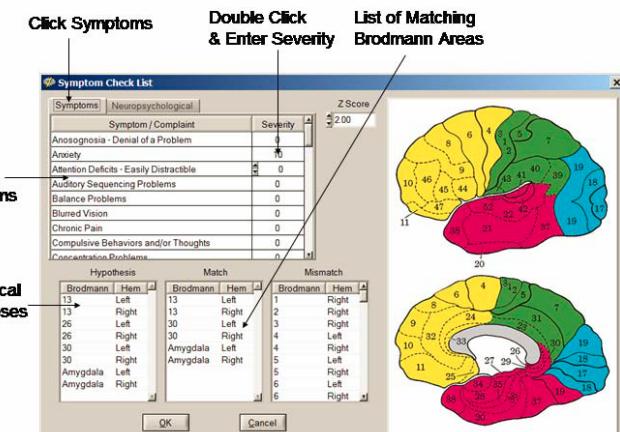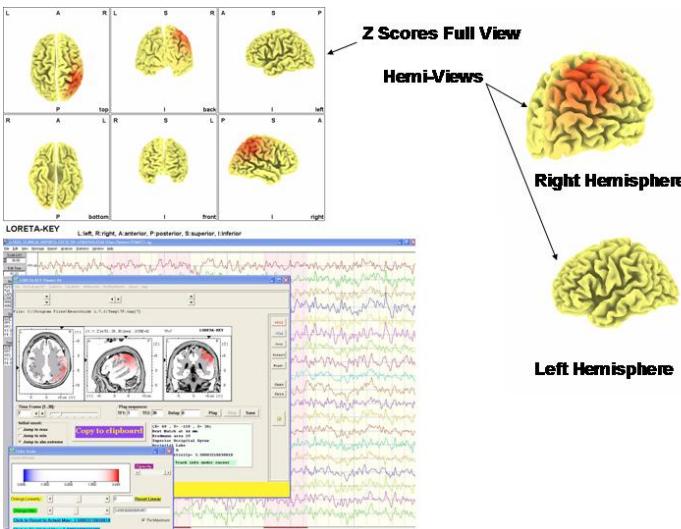
Theory
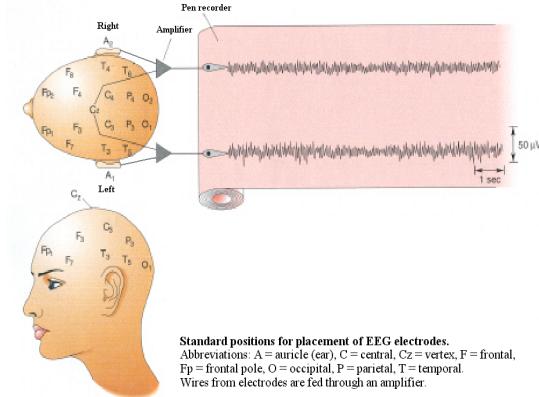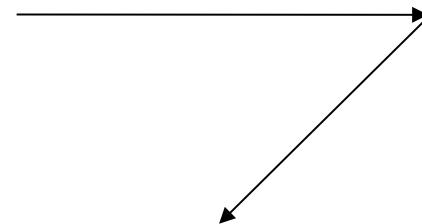
Standard positions for placement of EEG electrodes.
Abbreviations: A = auricle (ear), C = central, Cz = vertex, F = frontal,
Fp = frontal pole, O = occipital, P = parietal, T = temporal.
Wires from electrodes are fed through an amplifier.

Raw EEG

EEG

Power spectra

Phase spectra
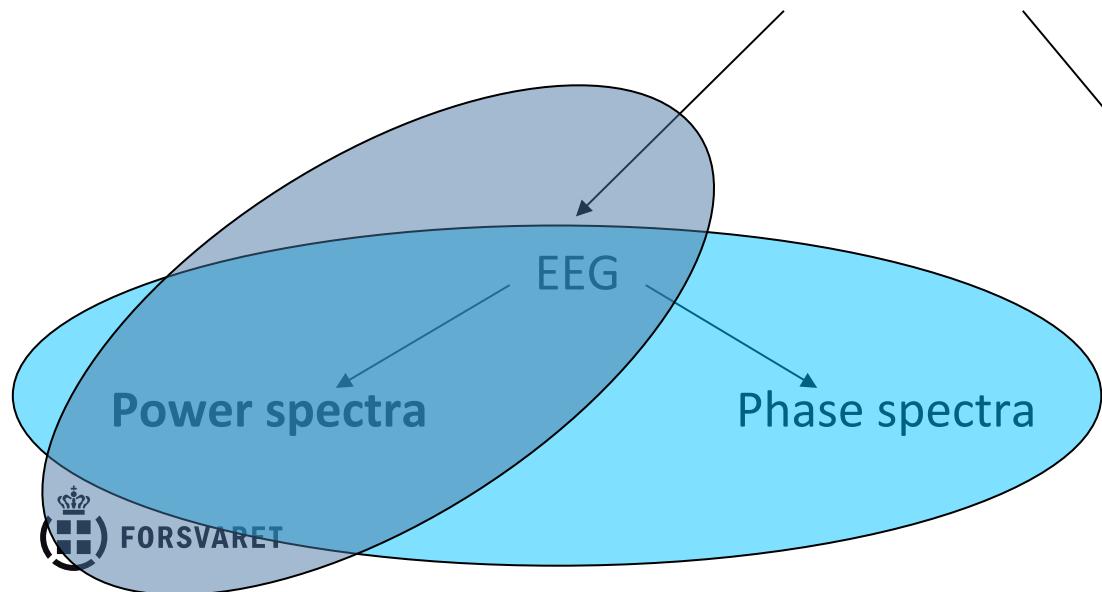
ERP
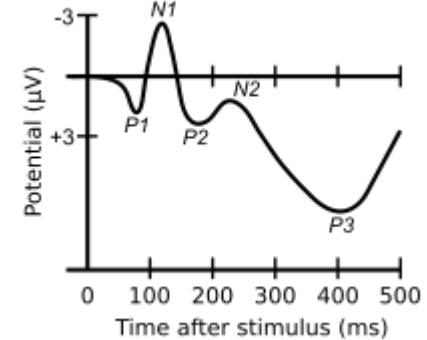
EEG Frequencies

- delta   0.5-4Hz

(a)

▶ theta   4-8Hz

(b)

▶ alpha   8-13Hz

(c)

▶ beta   13=30Hz

(d)

▶ gamma   >30Hz

(e)   Eyes open   shut
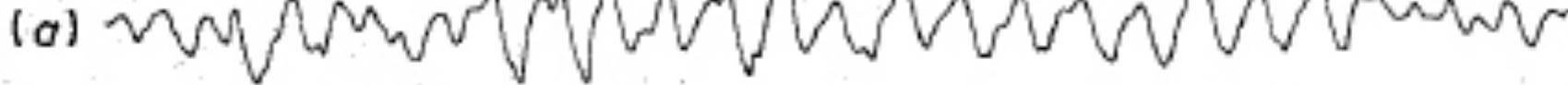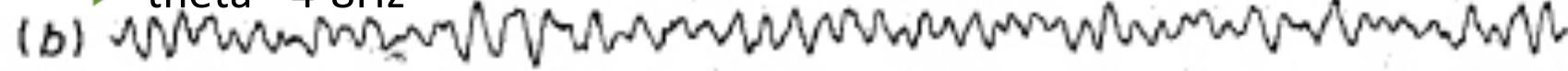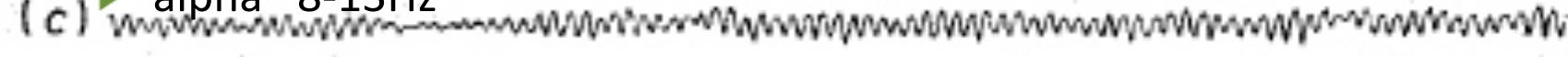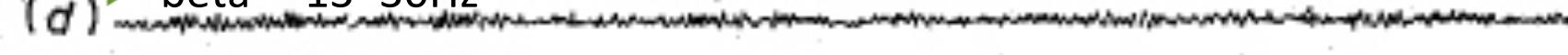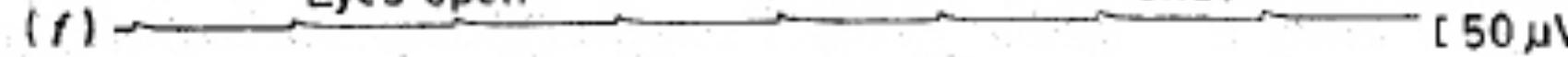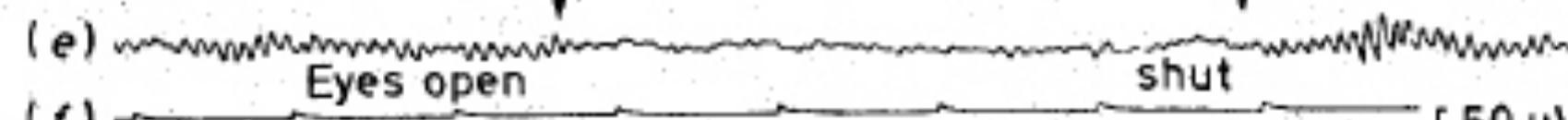
(f)   [50 μV

Figure 6.3 Examples of (a) delta, (b) theta, (c) alpha and (d) beta activity. (e) Blocking of the alpha rhythm by eye opening. (f) 1 s time marker

Frequency analysis

– Frequency analysis is a key component of the Clinical EEG examination
- Neurometrics

– Changes in the EEG Frequency Spectrum are seen in:
- Development and ageing
  - Peak Alpha
    - » 6Hz at 1 year
    - » 8Hz at 3 years
    - » 10Hz at 10 years ± 1Hz
    - » Decline in elderly

- Neuropathology
- Psychopathology
- Levels of consciousness
- Cognitive Processing

Normative Databases (1)

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Neurometrics (John, 1987)

**Thatcher Lifespan Normative EEG database
(LSNDB/NeuroGuide)**

Sterman-Kaiser (SKIL) Database

The International Brain Database

Table IV
List of "Gold Standards" by which to judge
QEEG Normative databases

|	Standards	Yes	No
1	Amplifier Matching		
2	Peer reviewed publications		
3	Artifact Rejection		
4	Test Re-Test Reliability		
5	Inclusion/exclusion criteria		
6	Adequate Sample size per age group		
7	Approximation to a Gaussian		
8	Cross-Validation		
9	Clinical Correlation		
10	FDA Registered		

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Normative Databases (2)

Normative Database Validation Steps
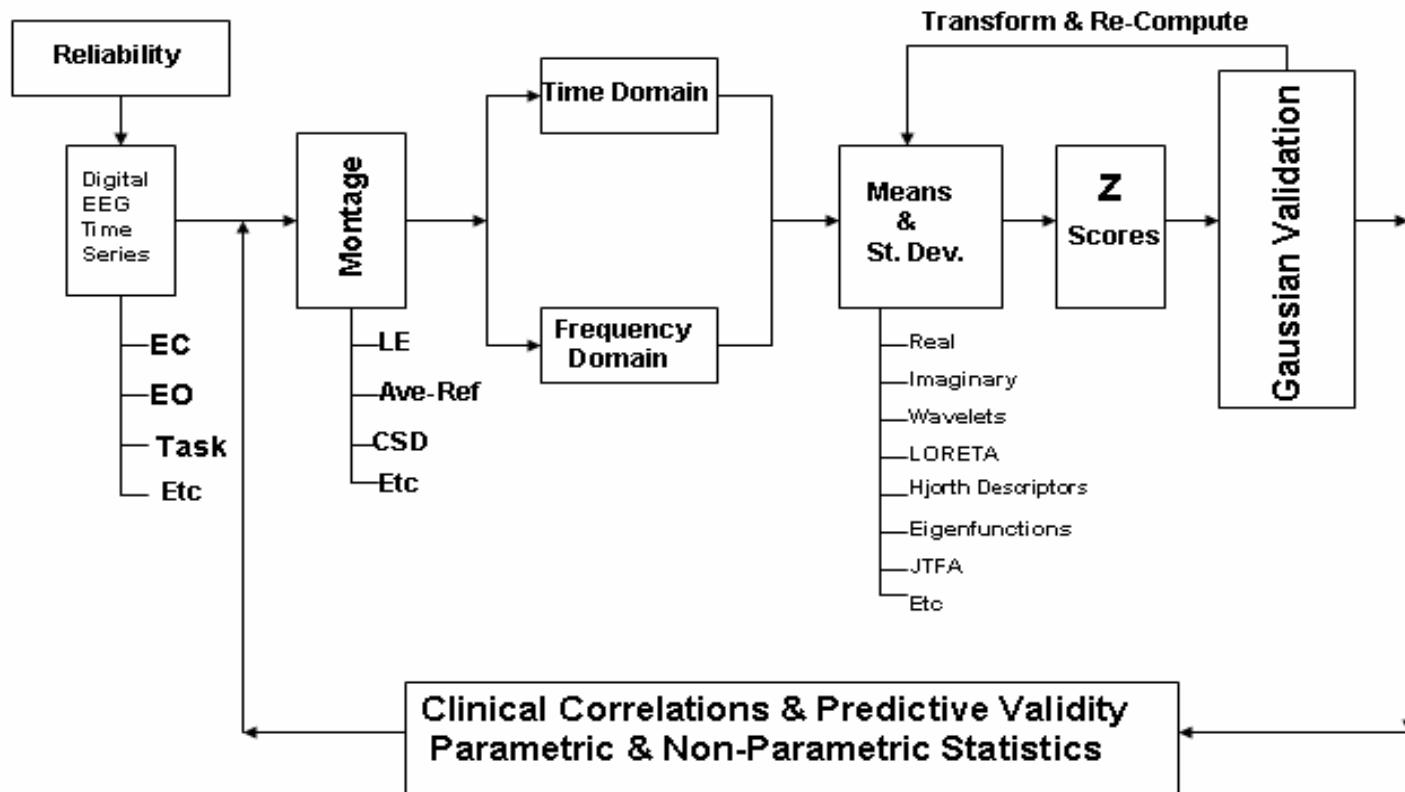
Normative Databases (3)

EYEs CLOSED EEG NORMATIVE DBASE_Sample Sizes_N=625 Subjects
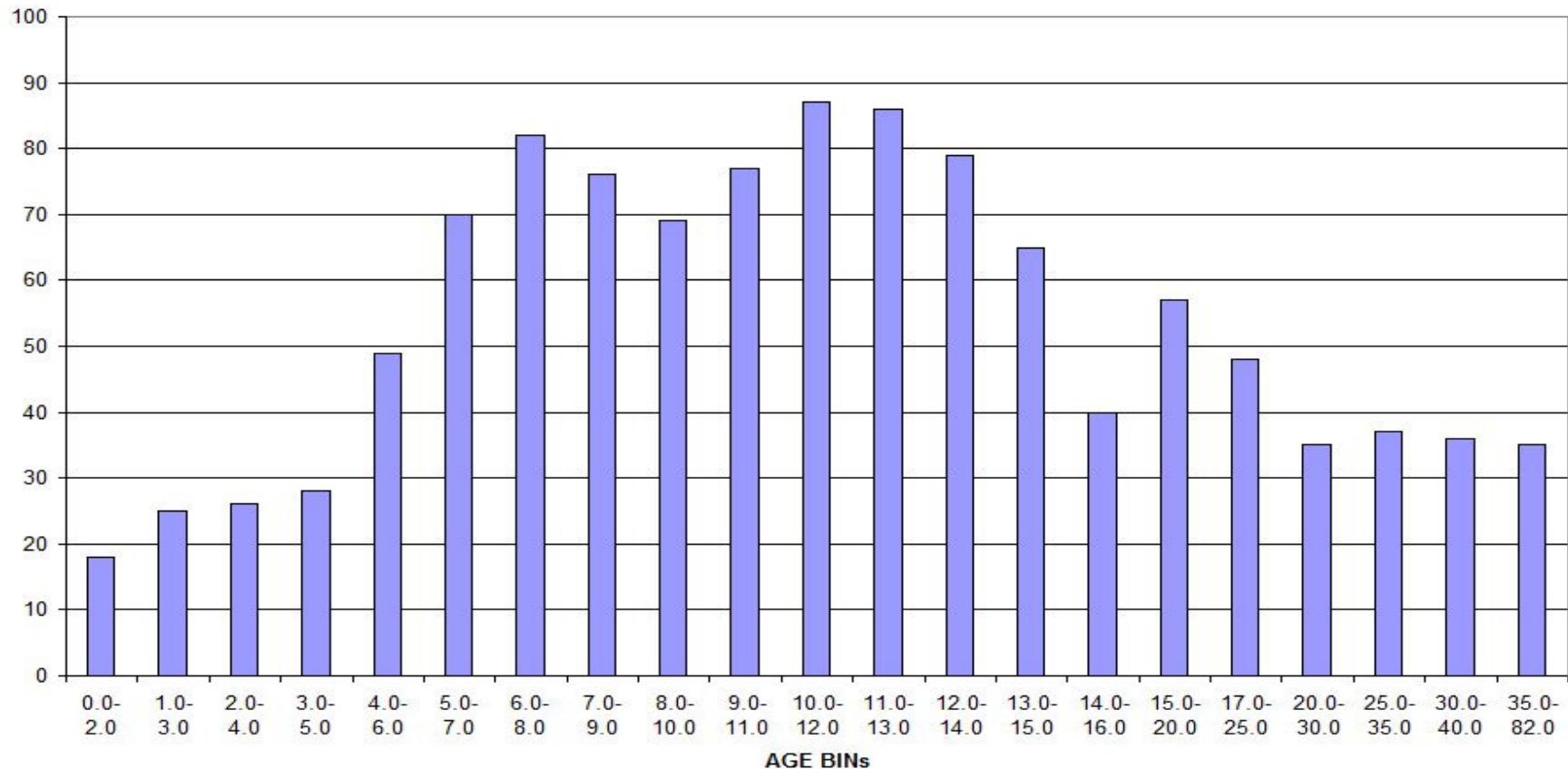
Click Symptoms

Double Click
& Enter Severity

List of Matching
Brodmann Areas

List of
Symptoms

Anatomical
Hypotheses

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Thank you for your attention!!!