AVANCERAD NEUROPSYKOLOGI-HT 2020

Elektrofysiologiska metoder och tillämpningar

Ingmar Rosén
Avdelningen för Klinisk neurofysiologi

- EEG och hjärnans elektrofysiologi
- Psykofysiologi
  - EEG
  - Hjärnreaktionspotentialer
  - TMS
- Epilepsi
- Demens
- Sömn

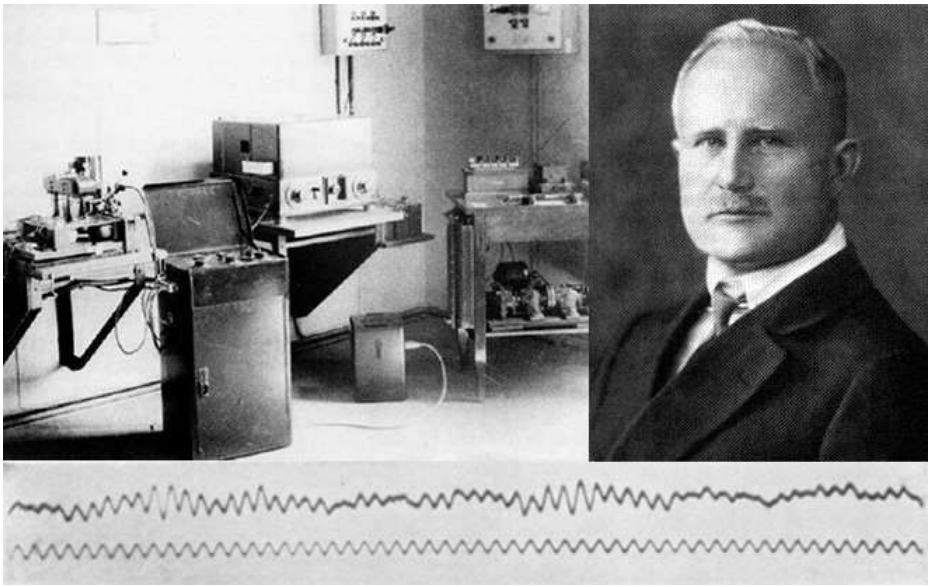
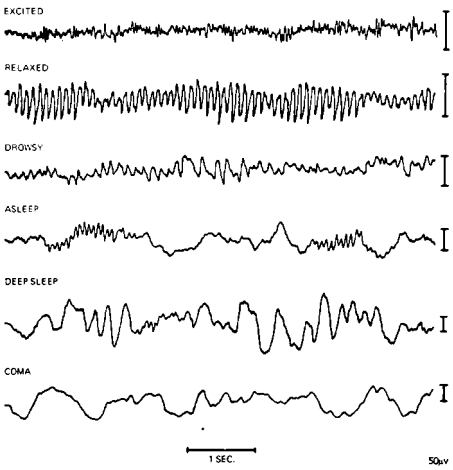


Figure 1.4. The first recorded electroencephalogram of a human. The lower line is a 10 cycles/sec sine wave for use as a time marker. The upper line is the recording from Berger's young son made in 1925. (From Berger, H. 1929. *Arch. Psychiat.* 87:527, with permission from Dr. Mary Brazier and Macmillan.)



Lord Adrian
Cambridge

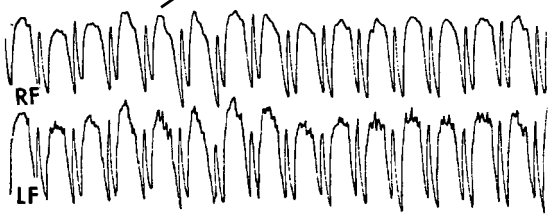
FIG. 47. Derbyshire (standing) and Lindsley (sitting). Early picture (December 12, 1934) of equipment and American scientists who engaged in confirmation of Berger's ideas.

EEG/ USA/ 1934

TABLE 1. *Early American clinical electroencephalography after Hans Berger (1930s)*[a]

Normal	Sleep EEGs	Children	Epilepsy	Early records from exposed human brain	Localization of brain tumor
Jasper & Carmichael (1935)	Loomis, Harvey, & Hobart (1935)	Kreezer (1936)	Gibbs, Davis, & Lennox (1935)	Sachs, Schwartz, & Kerr (1939)	Case & Bucy (1938)
Bagchi (1936)	Davis et al. (1937)	Lindsley (1936)	Gibbs, Lennox, & Gibbs (1936)	Scharff & Rahm (1941)	Williams & Gibbs (1938)
H. & P. Davis (1936)			Gibbs & Lennox (1937)		Yeager (1938)
			Jasper & Hawke (1938)		
			Jasper & Nichols (1938)		

[a] Other references to early U.S. literature are provided by D. B. Lindsley (1944).



Four of the original Trustees of The Grass Foundation. From left to right: Albert Grass, Frederic Gibbs, Ellen Grass, Robert Morison, and Erna Gibbs (not a Trustee) at the III International Congress of Electroencephalography and Clinical Neurophysiology held in Boston from August 17–21, 1953.

THE

CEREBRAL CORTEX OF MAN

A Clinical Study of Localization of Function

BY

WILDER PENFIELD, C.M.G.,

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AND

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1950

CASE A.D. This woman was having transient attacks of aphasia, and when our associate, Dr. Jasper, took an electroencephalogram during such a seizure (Fig. 85) he found that a circumscribed "spike" discharge was

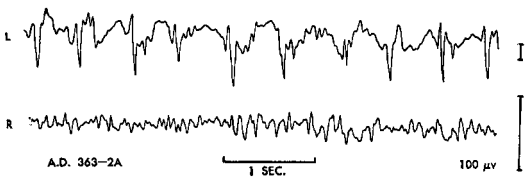
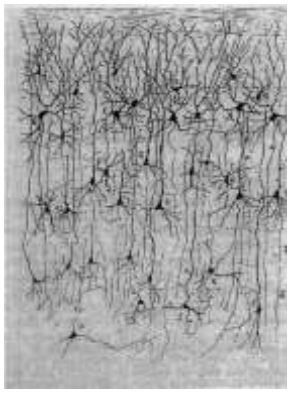
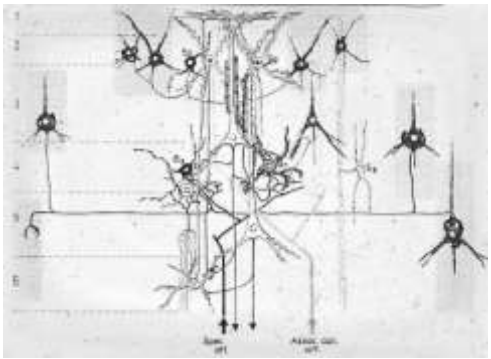
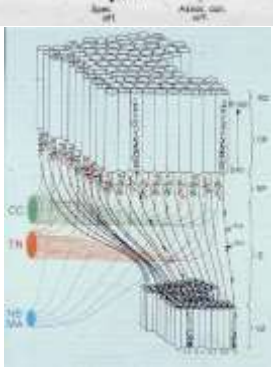


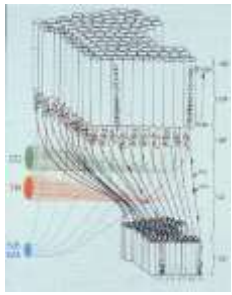
Fig. 85. CASE A.D. Electroencephalographic record of an aphasic seizure. The upper line is recording from lower posterior frontal area of left side. The lower line gives the record from a corresponding position of the other side.

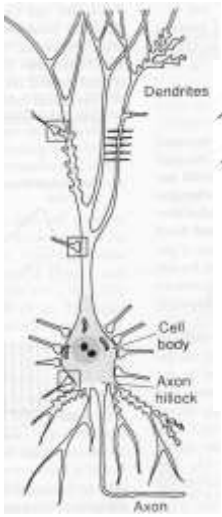
occurring in Broca's area of the dominant hemisphere. She did not say words nor talk nonsense. She remained silent, but she thought to herself—"Here is one of those fits which has taken away my ability to speak, but I can go on with what I am doing just the same so that no one will suspect what is wrong."

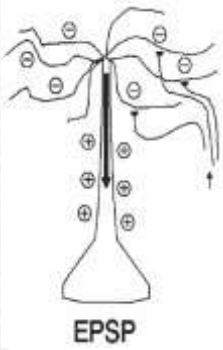


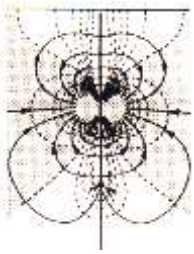


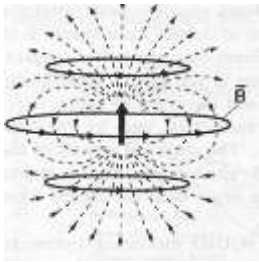


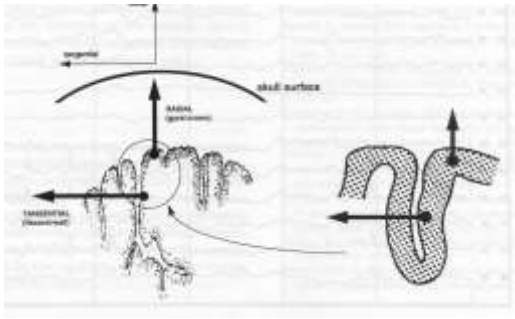


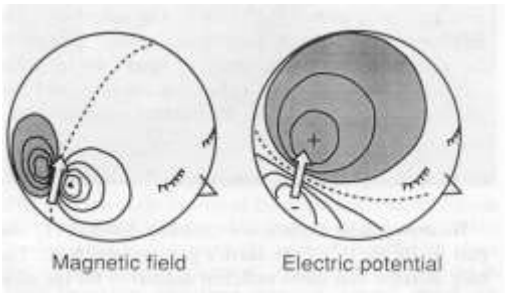

Dendrites
Cell body
Axon hillock
Axon

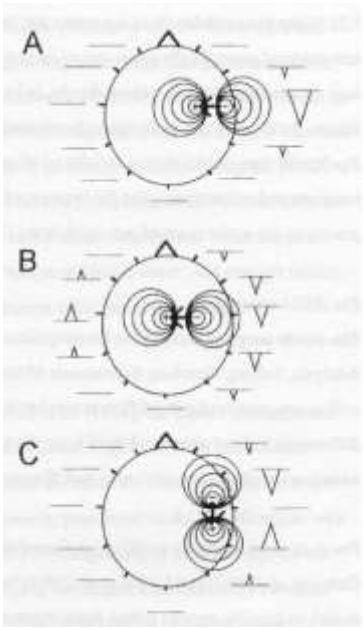

EPSP

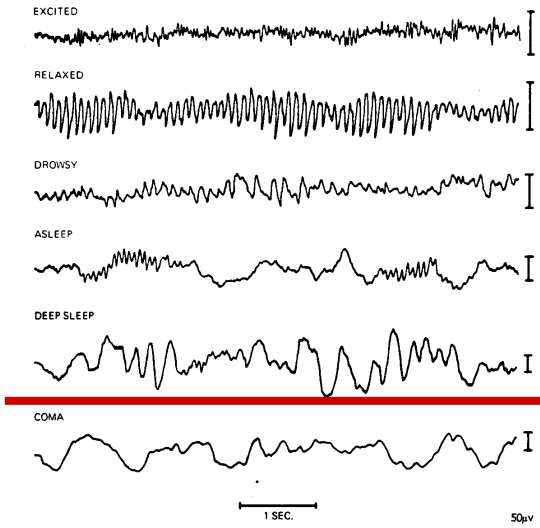


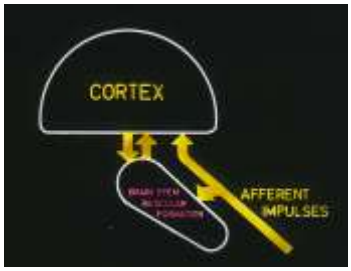

B


skull surface

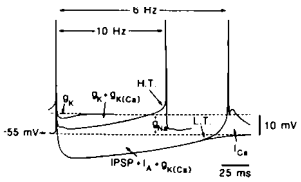

Magnetic field
Electric potential


A
B
C

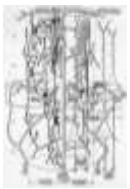




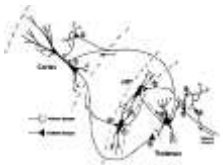
1 Intrinsic rythm generators

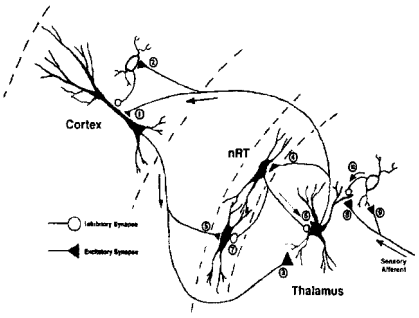


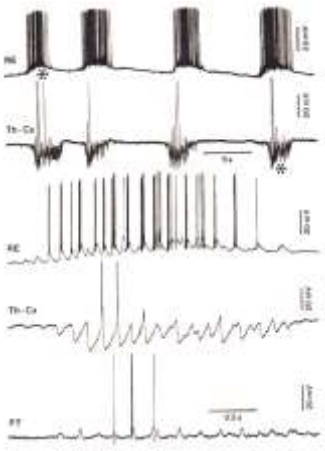
2 Intracortical recurrent circuits



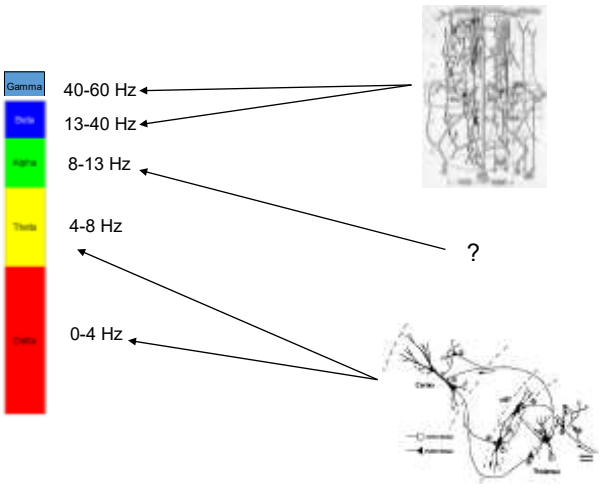
3 Cortico-thalamic recurrent circuits



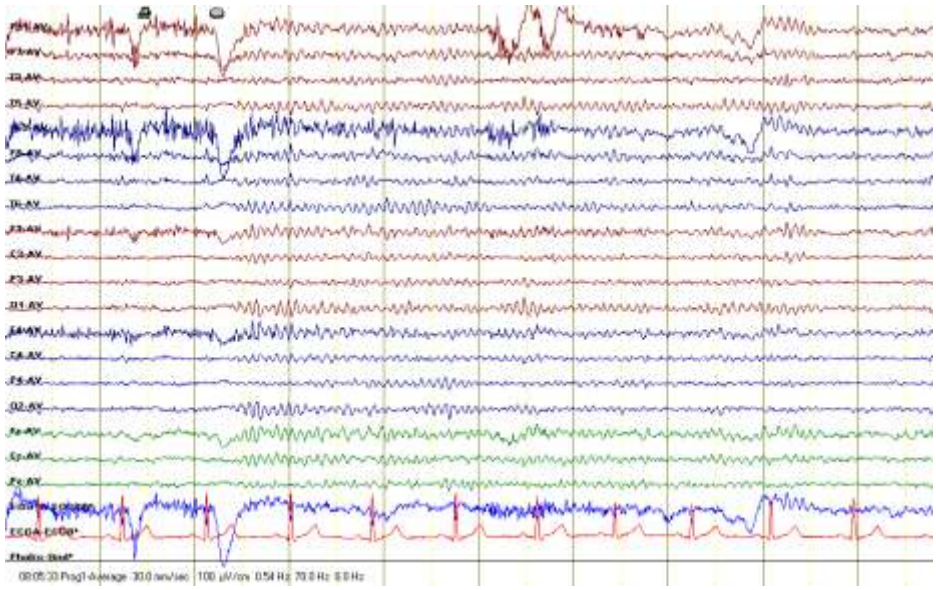

Cortex
nRT
Thalamus
Inhibitory Synapse
Excitatory Synapse
Sensory Afferent



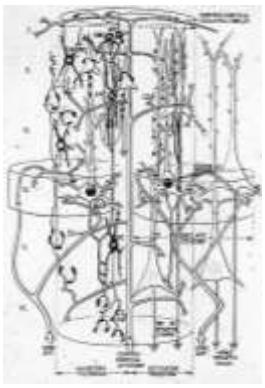

ASLEEP

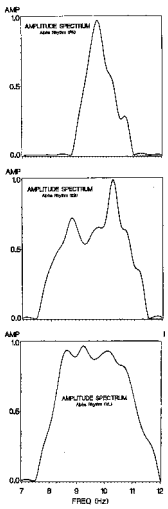

Gamma
Beta
Alpha
Theta
Delta
40-60 Hz
13-40 Hz
8-13 Hz
4-8 Hz
0-4 Hz
?

Normal adult EEG



Complexity of alpha generators (Nunez)





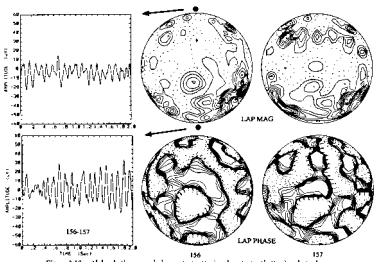


Figure 3-16. Alpha rhythm recorded on anterior (top) and posterior (bottom) scalp is shown at left. Spline-Laplacian magnitude and phase plots for two successive 1-second epochs are shown at right.

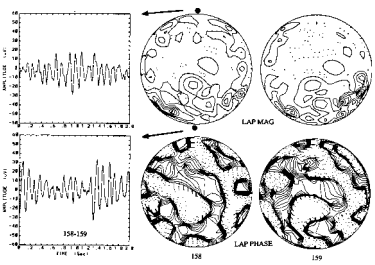
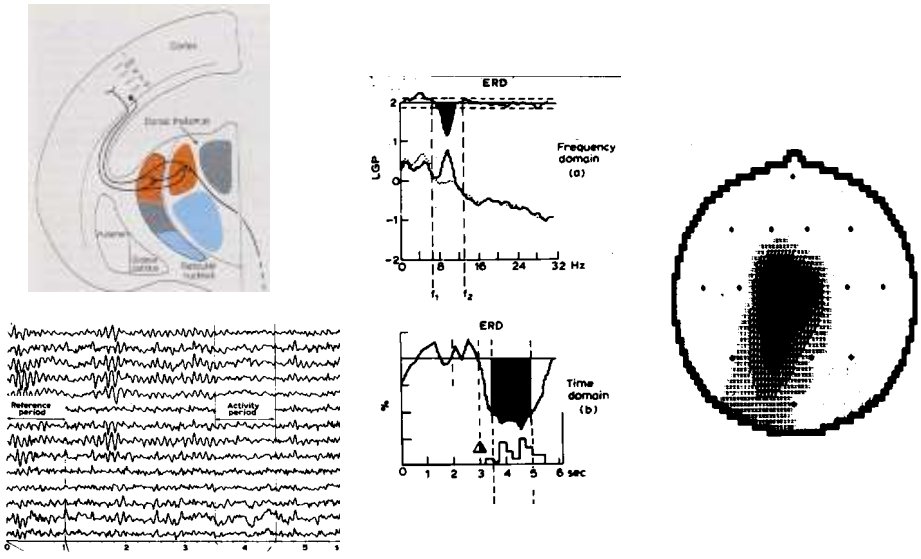
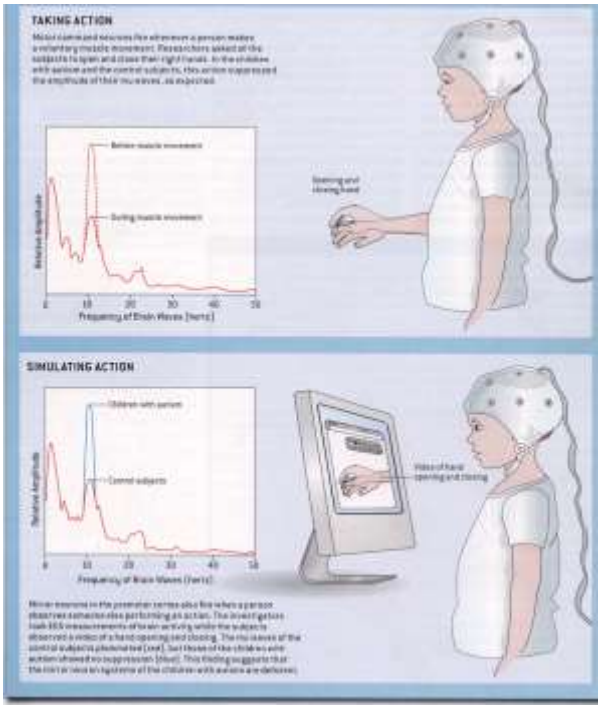
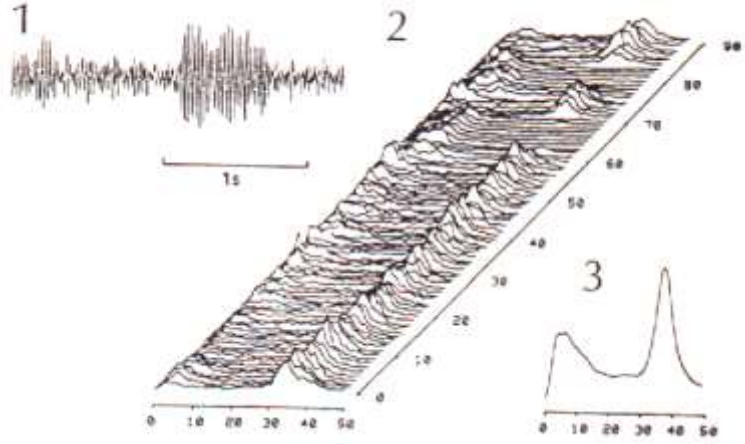


Figure 3-17. Alpha rhythm for 2 seconds following data shown in Figure 3-16.

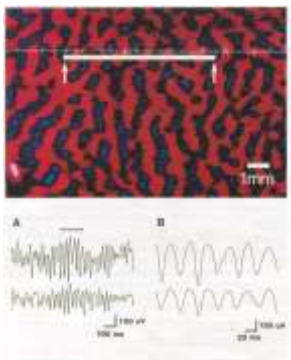


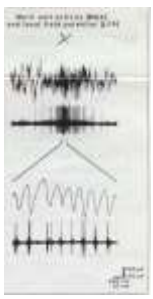
Regional desynchronisation (hand activation)

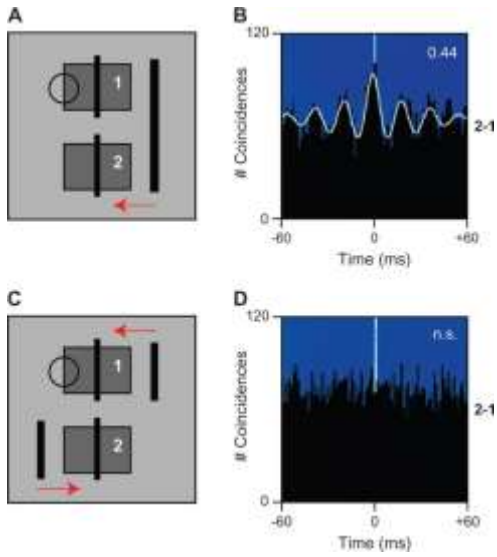




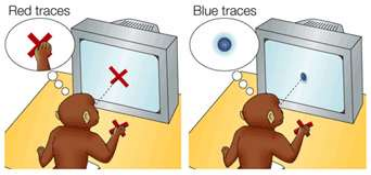
Cortical EEG in a cat focusing on a mouse

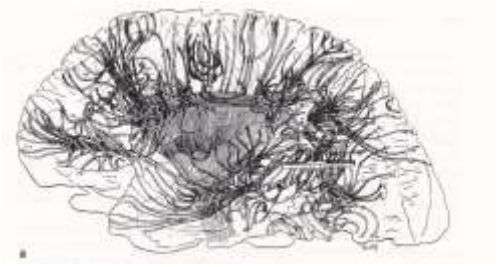


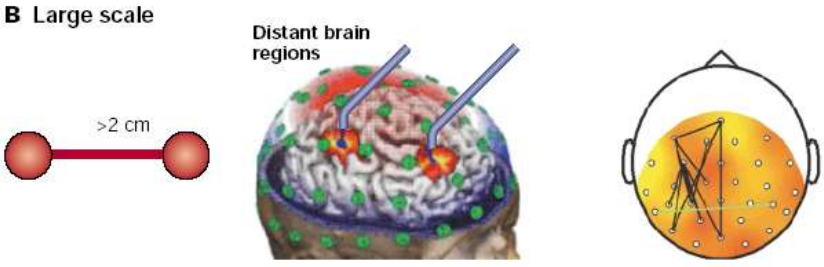




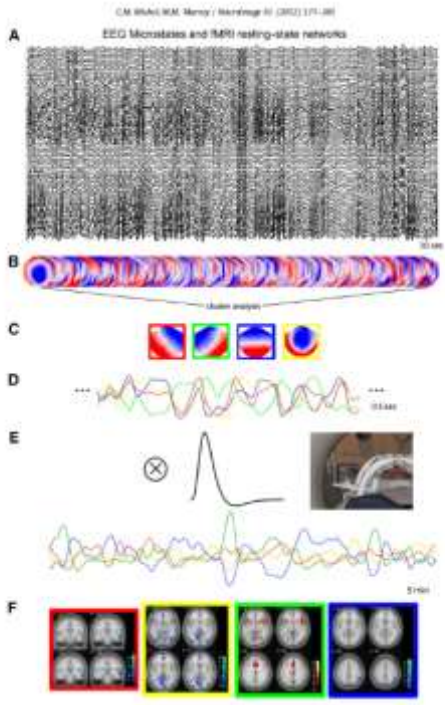
W Singer

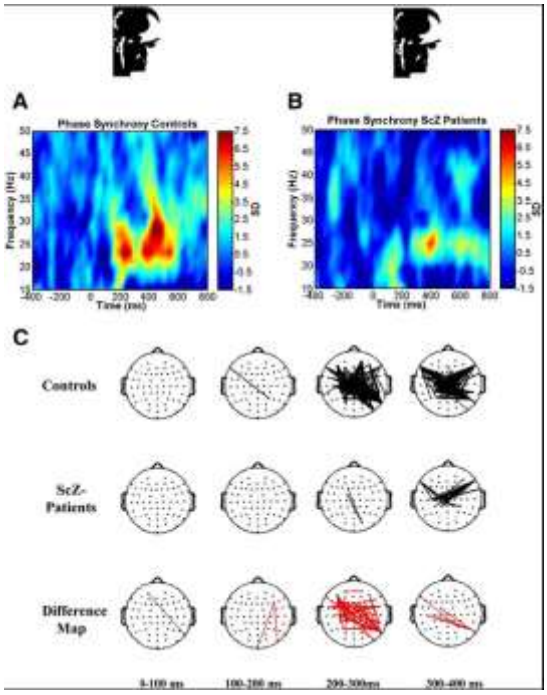






PSYKOFYSIOLOGI


A
EEG Microstates and fMRI resting-state networks
B
C
D
E
F



Uhlhaas, P.J., Linden, D.E.J., Singer, W., Haenschel, C., Lindner, M., Maurer, K., and Rodriguez, E. (2006). Dysfunctional long-range coordination of neural activity during Gestalt perception in schizophrenia. J. Neurosci. 26, 8168–8175.

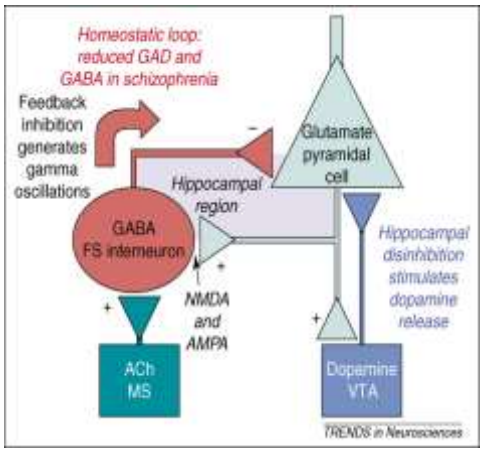
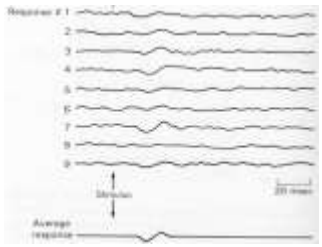
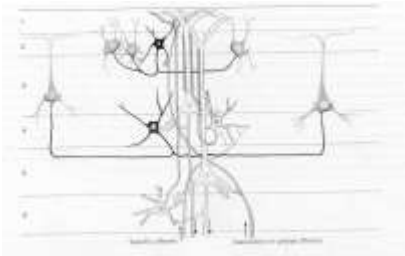


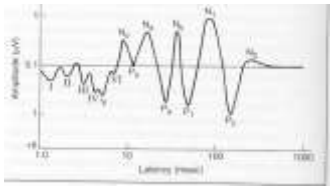
Figure 1. Simplified circuitry that provides a framework for understanding the actions of neurotransmitters and risk genes in schizophrenia. Two loops are shown: (i) the reciprocal interactions between pyramidal cells and fast-spiking interneurons and (ii) the hippocampal ventral tegmental area (VTA) loop (note that the connection between the hippocampus and VTA is shown as monosynaptic for simplicity, but is actually polysynaptic through the striatum and ventral pallidum). The effect of dopamine on the hippocampus is probably excitatory [109], raising the possibility that the hippocampal-VTA loop could go into positive feedback, thereby generating the sudden onset of psychosis. The reciprocal relationship of pyramidal cells and fast-spiking interneurons is ubiquitous in the hippocampus and cortex. This loop is responsible for homeostasis of firing of pyramidal cells and for the generation of gamma frequency oscillations. Abnormalities in these oscillations might underlie cognitive and negative symptoms. Cholinergic input to fast-spiking (FS) interneurons is from the medial septal region (MS). ACh = acetylcholine.

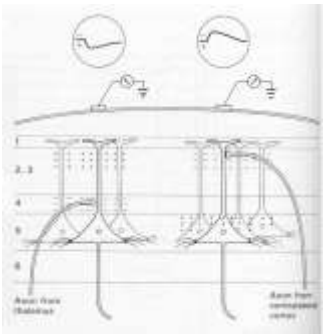
EVOKED POTENTIALS

Evoked potentials (hjärnreaktionspotentialer)

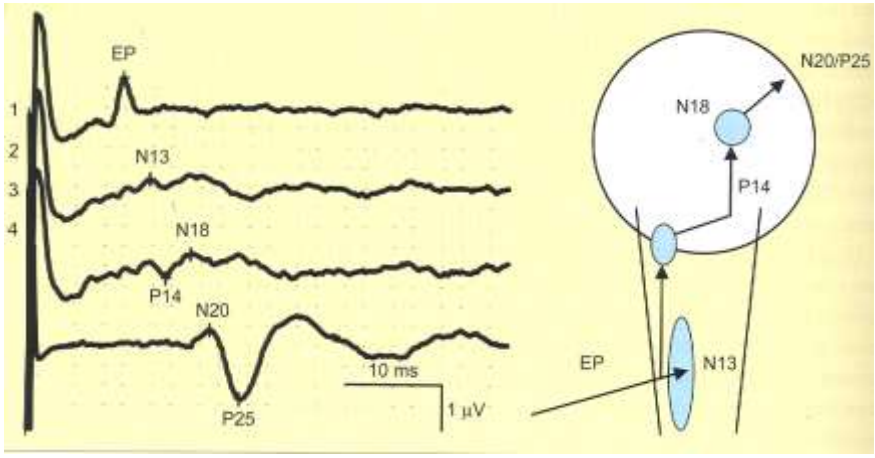




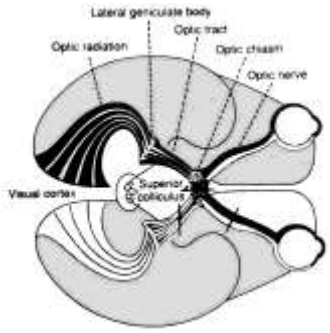


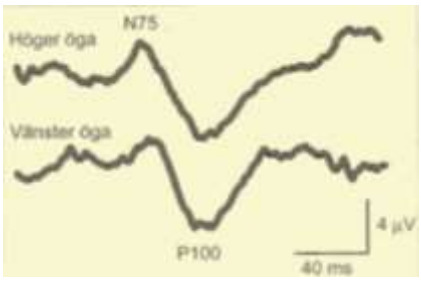


SEP stim N Medianus

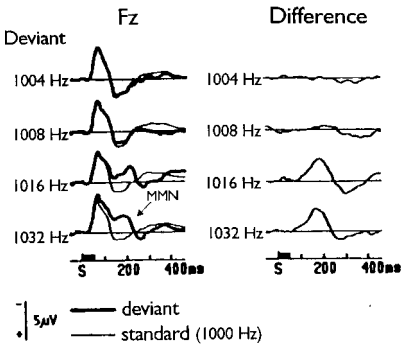


VEP

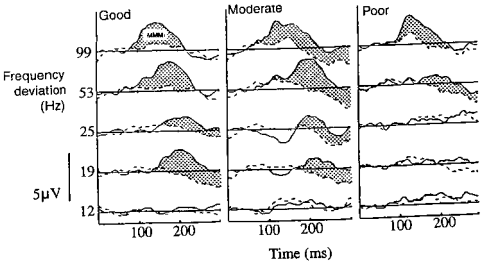


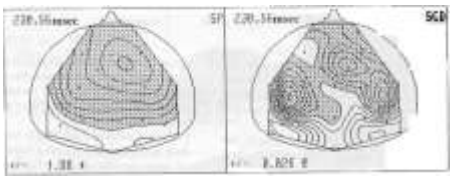


MMN as a Function of Frequency Change

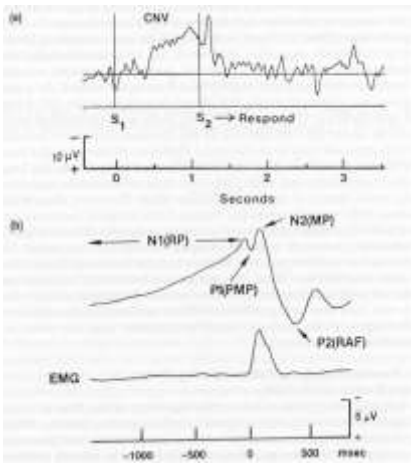


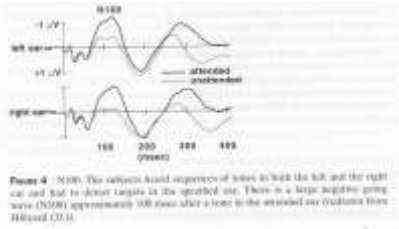
MMN as a Function of Discrimination Performance

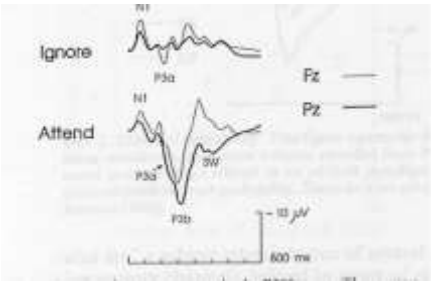


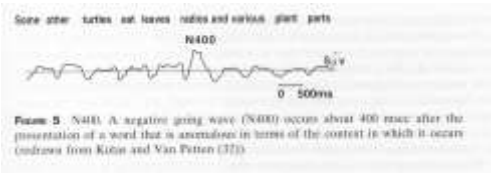


Cognitive ERP

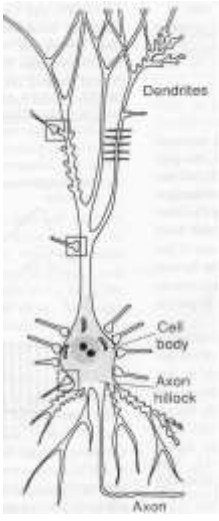


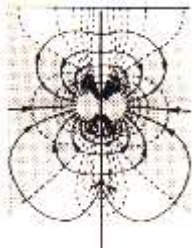


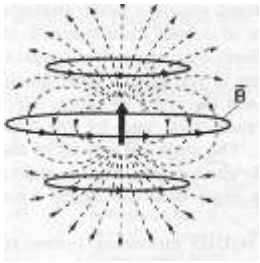


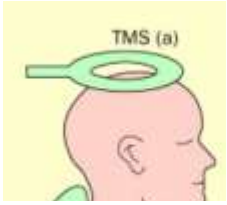


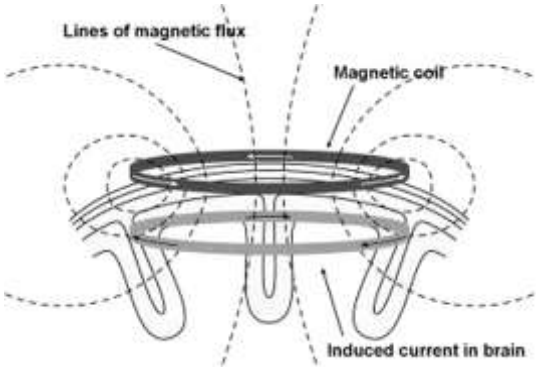
TRANSKRANIELL MAGNETSTIMULERING

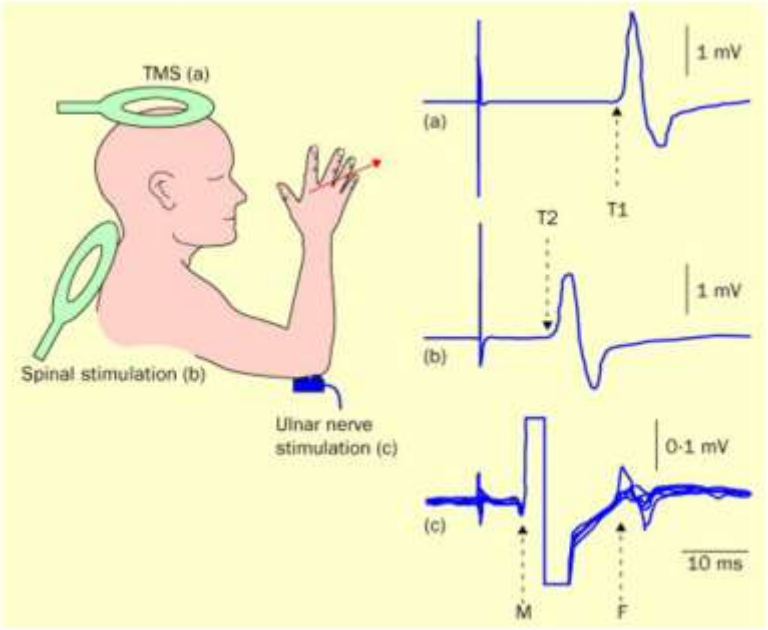


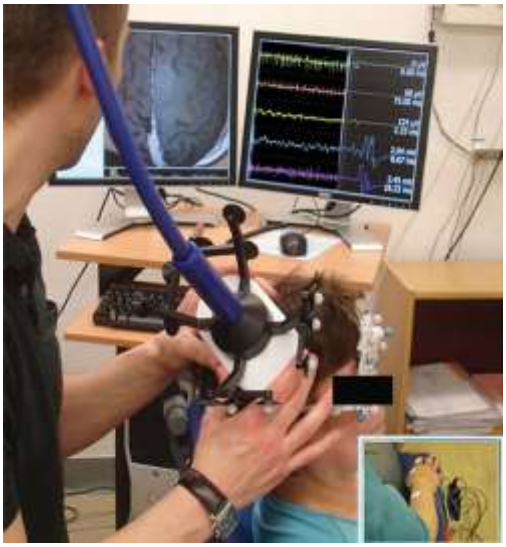


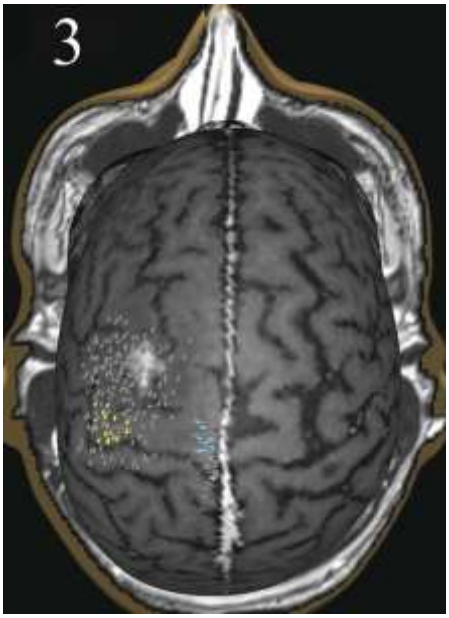


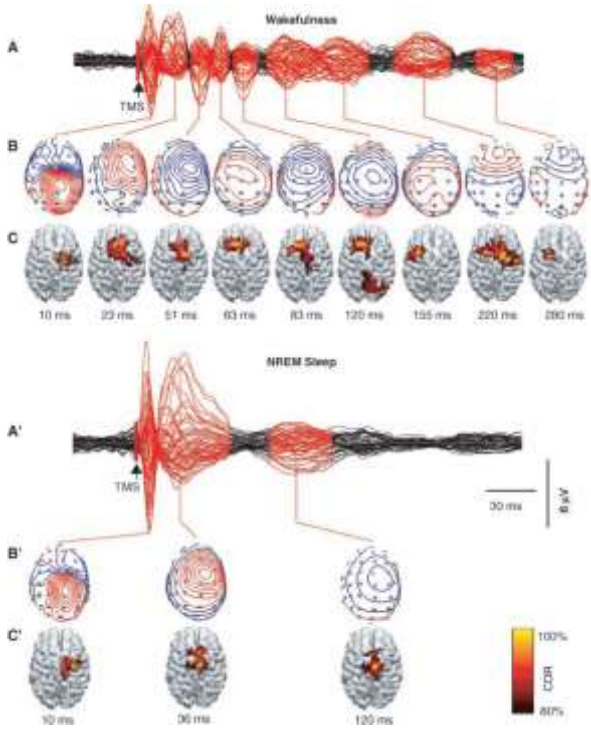





TMS (a)
Spinal stimulation (b)
Ulnar nerve stimulation (c)
1 mV
(a)
T1
T2
1 mV
(b)
0·1 mV
(c)
10 ms
M
F




3



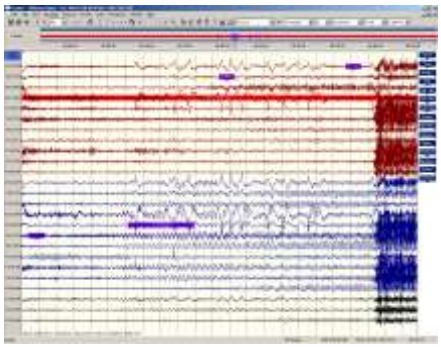
Evidensbaserade tillämpningar för dTMS-behandling

- Depression (vä F-lob)
- Smärta (sensori-motor kortex)
- Tinnitus (gyrus temporalis superior (hörselkortex))

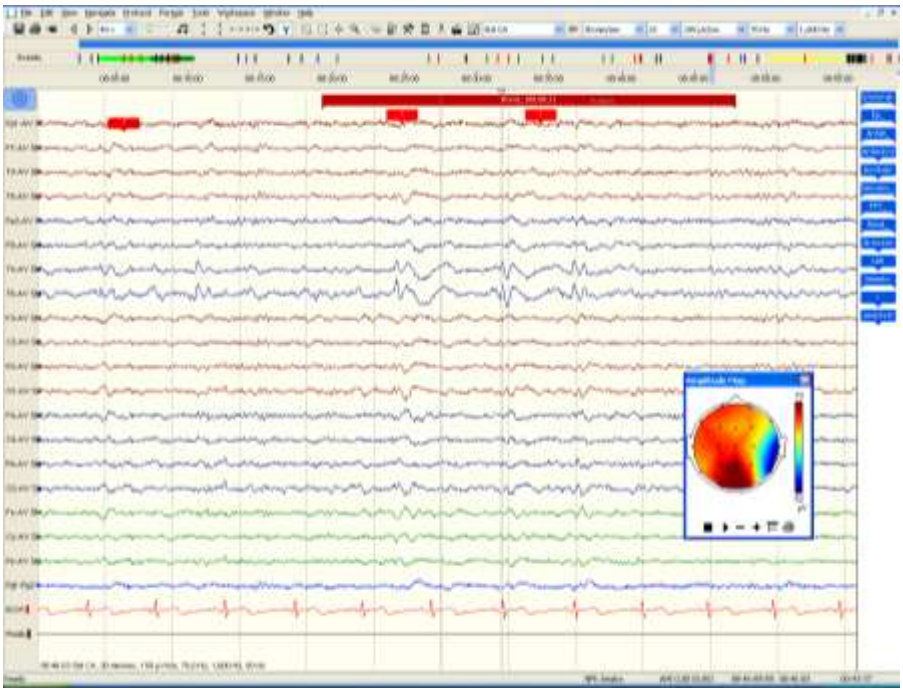
EPILEPSI

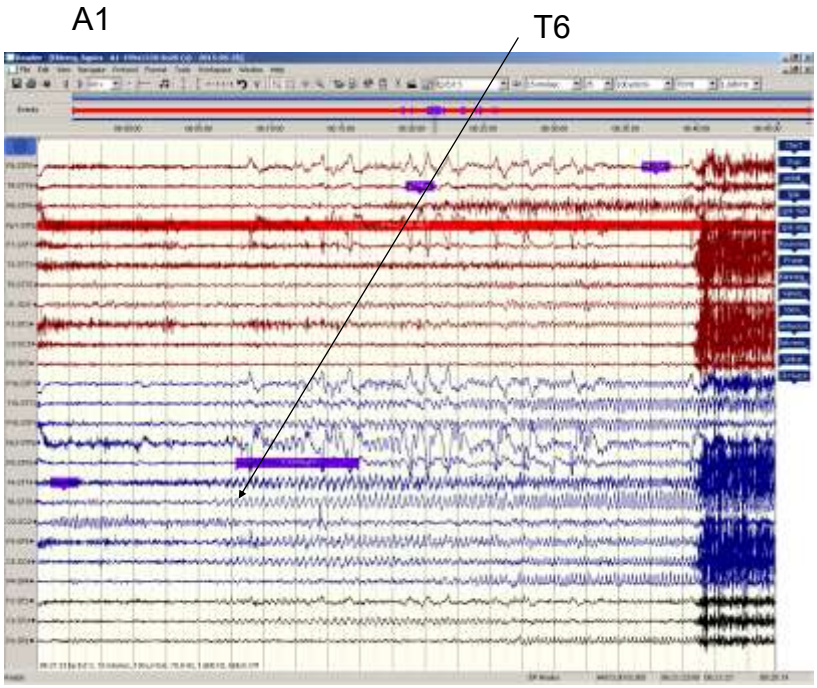
- Epilepsi innebär att en person har anfall som
  - är en följd av epileptiska urladdningar i hjärnan
  - upprepats (oftast haft minst två anfall)
  - är oprovocerade av akut skada eller sjukdom (vid normala omständigheter)
  - förekommit under senaste åren
- Epilepsi är en vanlig sjukdom
  - Förekommer hos cirka 60.000 personer i Sverige
  - Drygt 4.000 personer insjuknar årligen
  - Risken är störst för småbarn och äldre
- Prognosen varierar
  - De flesta blir anfallsfria
  - Anfallsfrekvensen varierar hos icke anfallsfria
  - Andra funktionsnedsättningar ökar anfallsrisken

Focal



Generalized





Epileptogenic lesion

+ offers a shortcut to surgery if concordant with other findings

- Present in less than half of cases

Functional deficit zone

Cortex with abnormal function
Between seizures

Neuropsychology
FDG-PET
+ specific for lateralety
- FDG_PET abnormality widespread

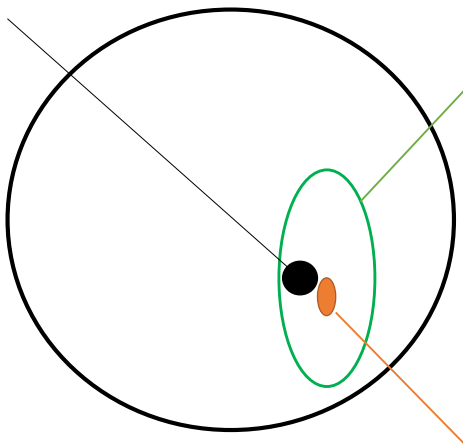
Symptomatic zone

Brain region producing ictal symptoms

+ strong localizing information

- may be effect of seizure propagation

Epilepsy surgery work up
Non-invasive phase



Irritative zone

Brain region producing interictal epileptiform discharges (EEG,MEG)

+ localizing information at sublobar level when enhanced by source imaging.

- Larger area than SOZ
- More than one IZ may be seen

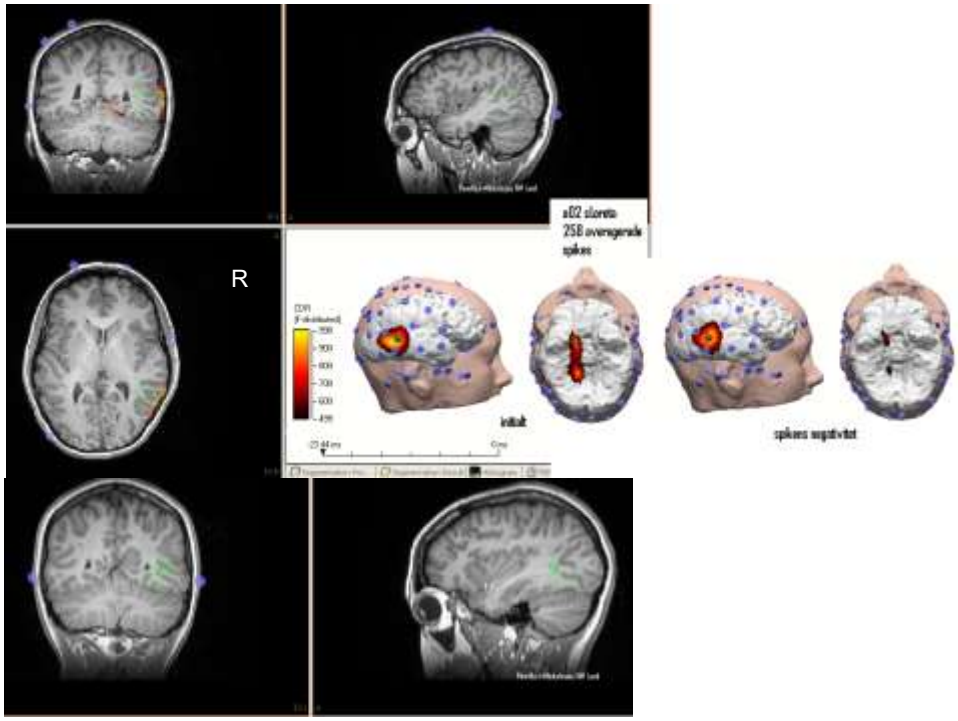
Seizure onset zone

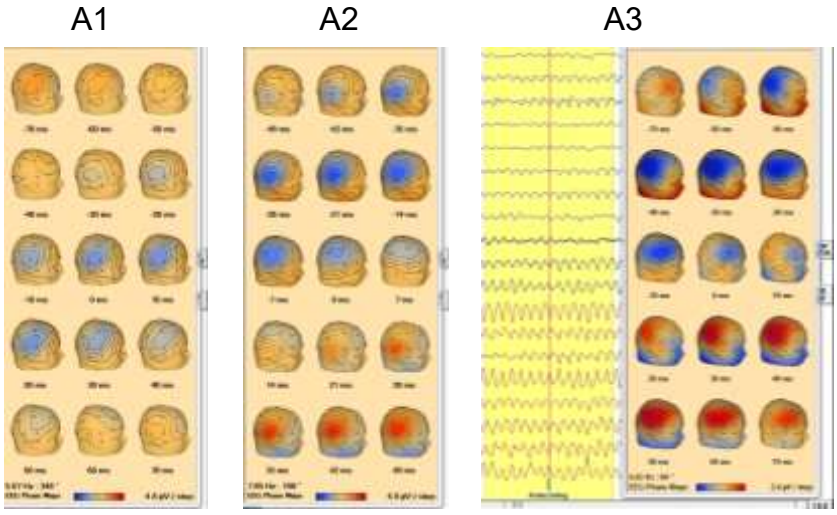
Brain region where the seizures originate

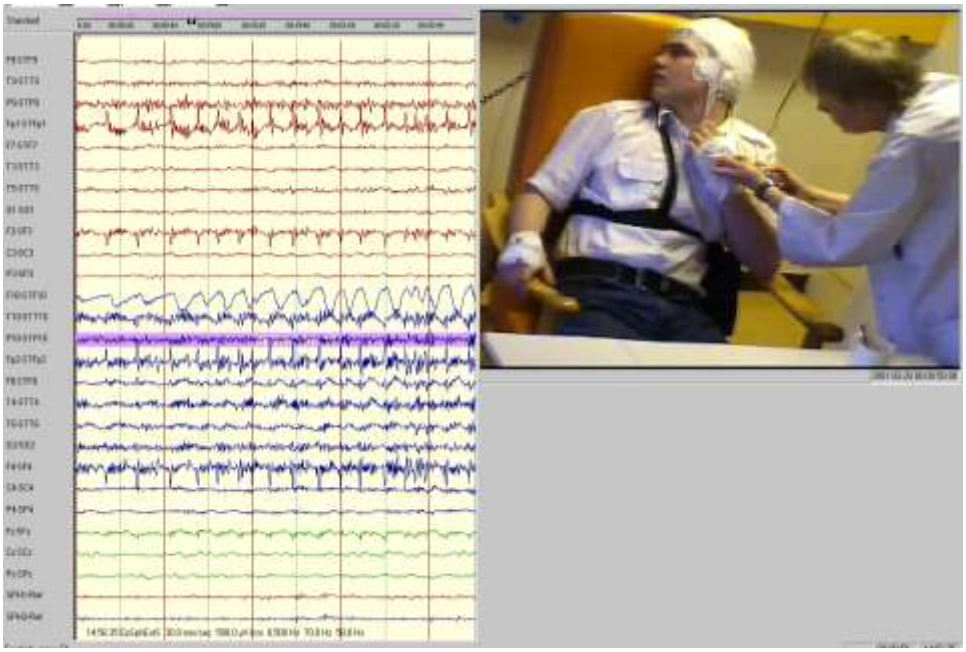
Ictal EEG-lobar level

SISCOM
+unique independent modality for localization of SOZ

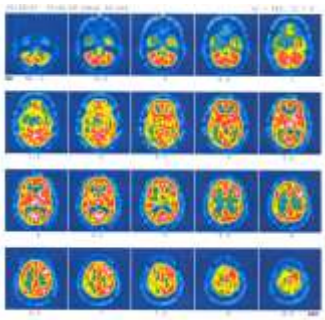
- Seizure propagation
- Timing of injection

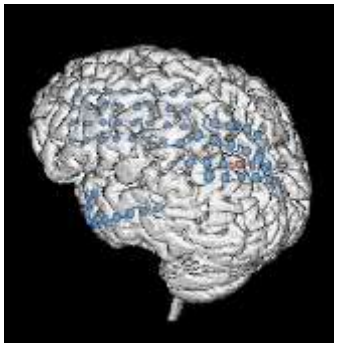

R
spikes negativitet

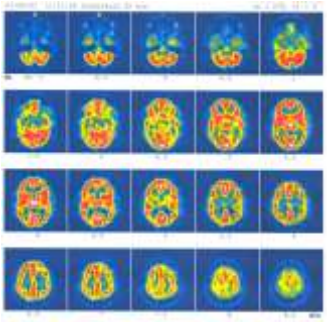

A1
A2
A3

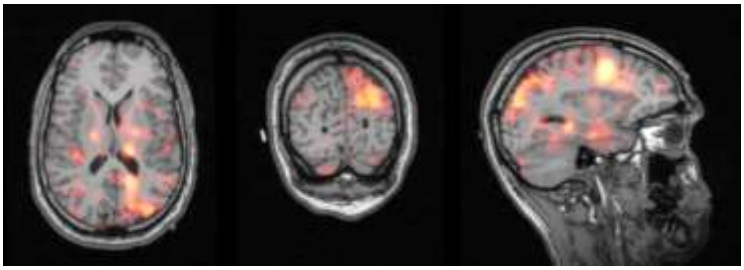


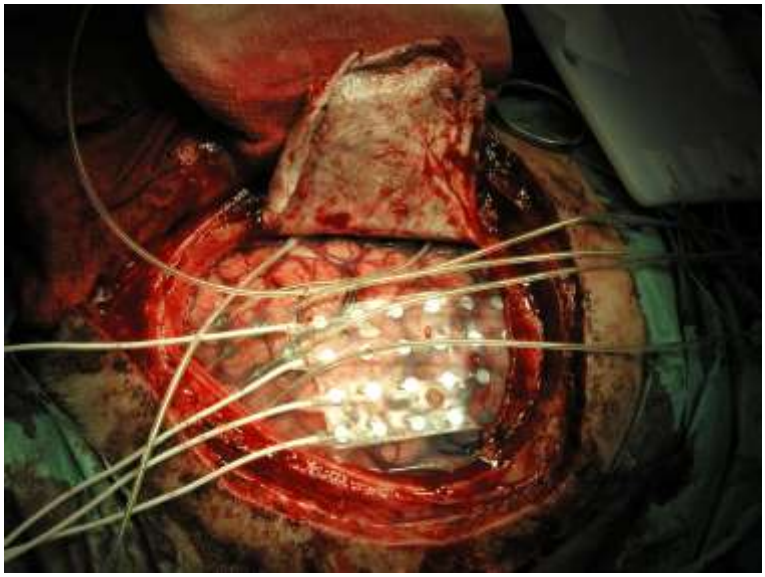
Extracranial monitoring HMPAO injection for ictal SPECT

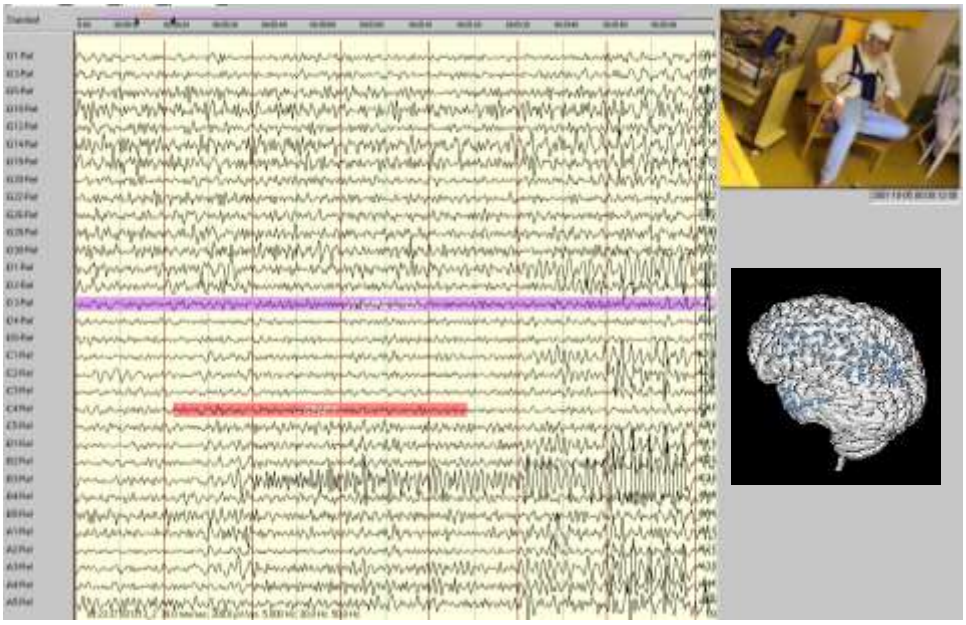






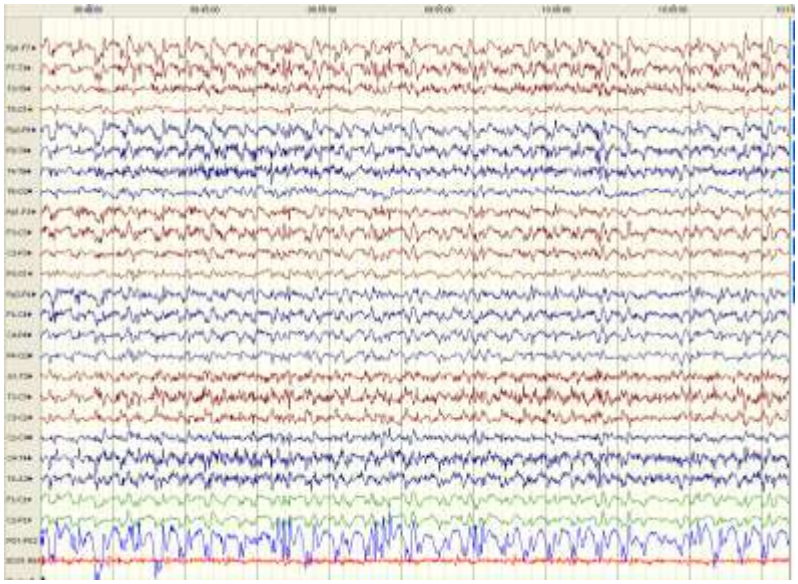




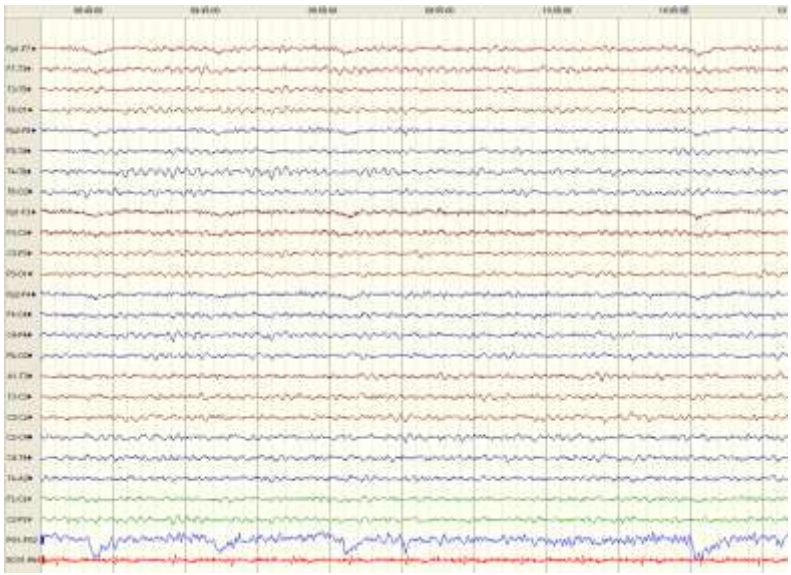


Invasive EEG-Video monitoring - Start of seizure

Petit mal status

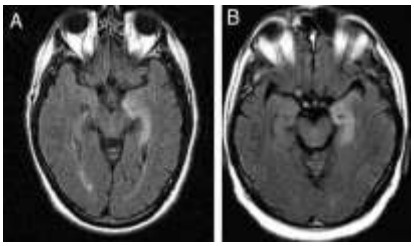


Petit mal status-normaliserat EEG (och patient) efter 5 mg Stesolid i.v.



Limbisk encephalit

- Minnes-störning, konfusion, kramper
- CSF, EEG, MR

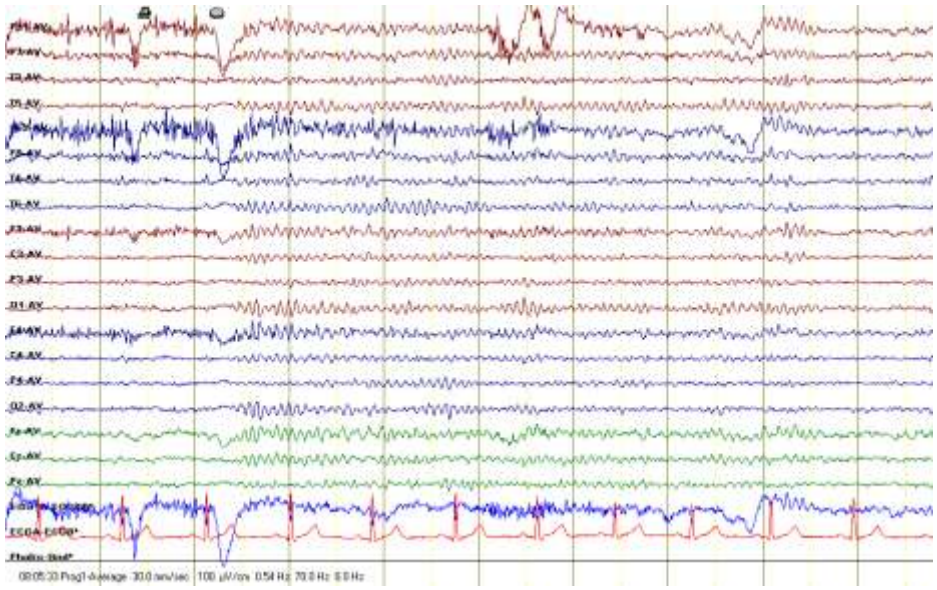


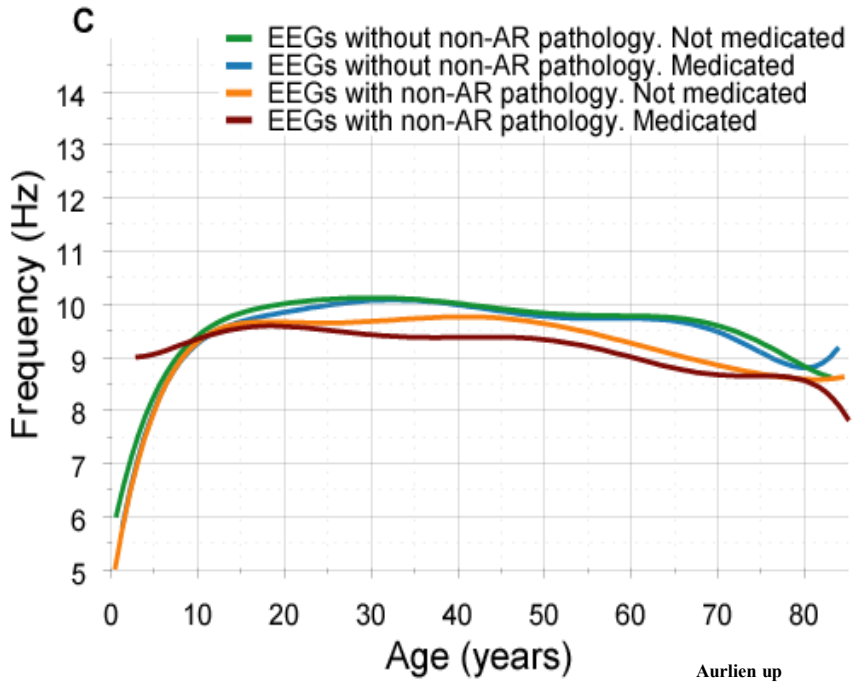
The most frequent clinical scenario is a young woman who a few days after a flu-like illness (fever, headache, malaise, or fatigue), develops anxiety, and mood and affective disorders progressing to severe behavioral and personality disturbances, delusional or disorganized thinking, paranoid ideation, and hallucinations.[19] Patients are usually first seen by psychiatrists or admitted to psychiatric wards with the diagnosis of acute psychosis or schizophrenia. At this stage or later, patients may remain with eyes open, unresponsive to visual threats, mute or mumbling unintelligible words, with increased muscle tone, and dystonic or cataleptic postures resembling a catatonic state.[59] This clinical picture may associate with seizures and decline of level of consciousness, central hypoventilation, autonomic instability, and dyskinesias. Because many patients are sedated and intubated to manage the aggressive behavior and seizures, the central hypoventilation is often noted when attempts are made to wean them from the ventilator. The autonomic instability may include intense fluctuation of blood pressure and temperature, tachycardia, bradycardia, cardiac pauses, and diaphoresis.[60] The dyskinesias almost always start in the face and mouth, manifesting as orofacial movements, clenching of the teeth, jaw dystonia, and may associate with rhythmic contractions of abdominal muscles, and complex movements of the extremities.[13,19] These dyskinesias do not have epileptic correlates in EEG monitoring, which usually shows diffuse delta-theta activity.

Diagnostiskt är det värt att observera att endast 55 procent uppvisade avvikande fynd på MR hjärna. Däremot förekom avvikande fynd i ryggmärgsvätska hos 95 procent, vanligast i form av lymfocytär pleocytos (91 procent), samt EEG-avvikelser med långsam (71 procent) eller epileptisk (21 procent) aktivitet [2]. Sammantaget är det en bild som stämmer väl med den fallbeskrivning som här presenteras.

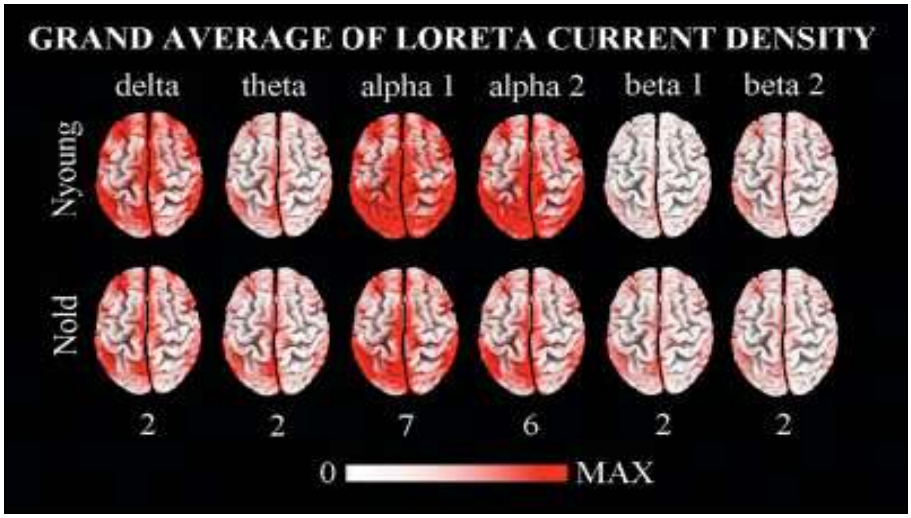
DEMENS

Normal adult EEG



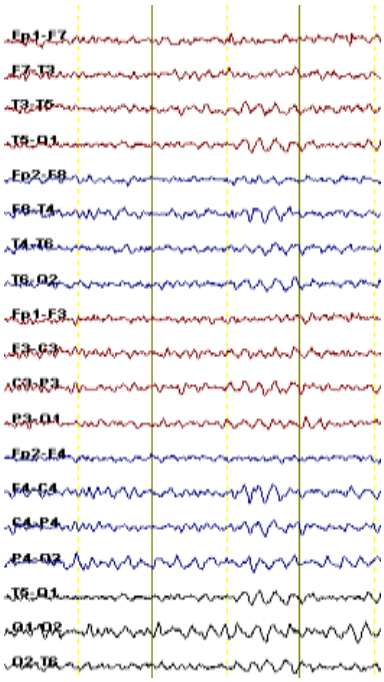


Aurlien up

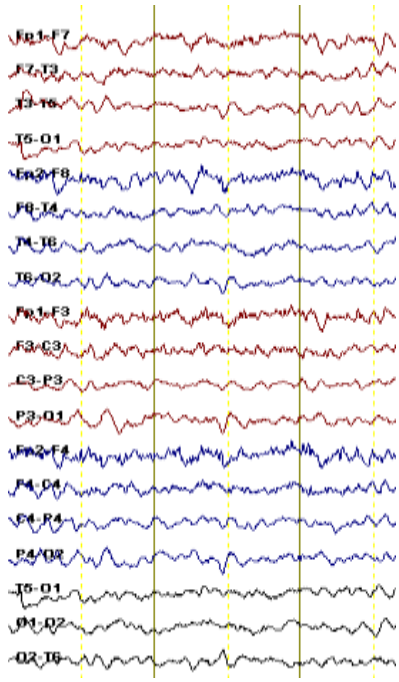


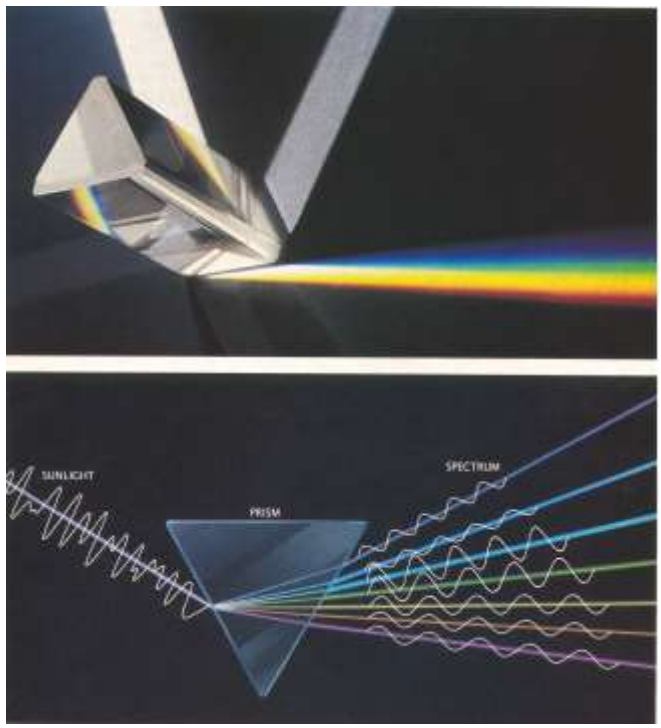
Babiloni et al 2006

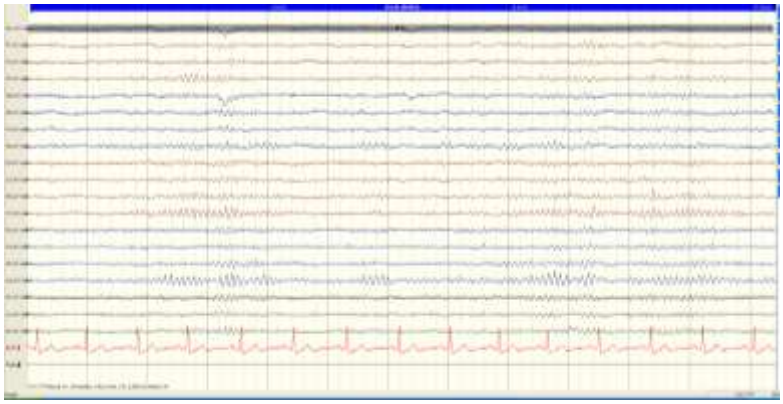
A

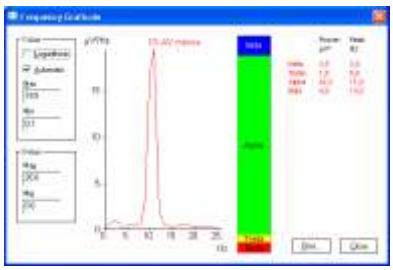

Fp1-F7
F7-T3
T3-T5
T5-O1
Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
Fp2-F4
F4-C4
C4-P4
P4-O2
T5-O1
O1-O2
O2-T6

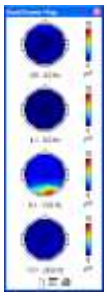
B

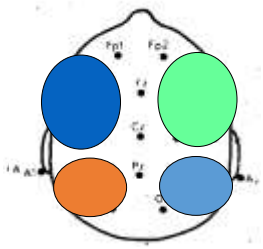

Fp1-F7
F7-T3
T3-T5
T5-O1
Fp2-F8
F8-T4
T4-T6
T6-O2
Fp1-F3
F3-C3
C3-P3
P3-O1
Fp2-F4
P4-C4
C4-P4
P4-O2
T5-O1
O1-O2
O2-T6


SUNLIGHT
PRISM
SPECTRUM









Recording Start:	10:09:37 2006-05-15	Technologist:	Ej
Recording End:	10:24:54 2006-05-15	Reference File:	test.dat

Epoch Information

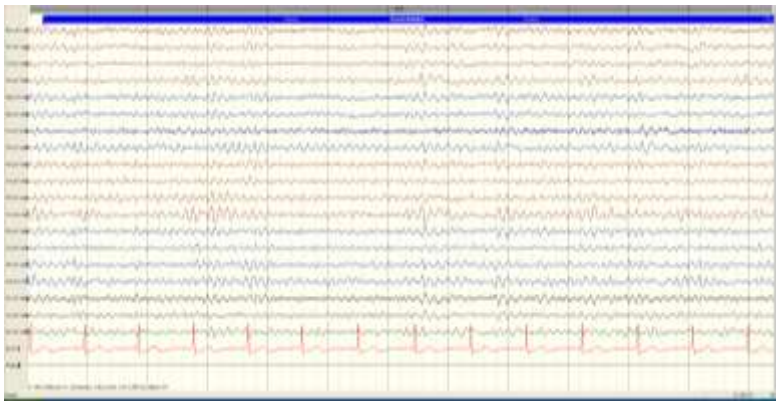
Start Time	Duration
2006-05-15 10:17:47	00:00:12

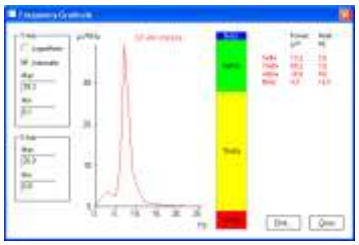
Absolute Power (Log)	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	0.85	0.90	0.48	1.03
Theta	-0.09	0.07	0.32	0.51
Alpha	1.99	2.01	3.15	3.50
Beta	1.18	1.14	1.51	1.54

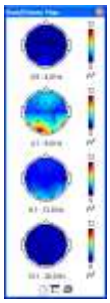
Absolute Z-score	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	-0.69	-0.72	-0.26	0.67
Theta	-1.36	-1.15	-0.30	0.07
Alpha	0.28	0.34	1.06	1.33
Beta	-0.16	-0.16	0.81	0.77

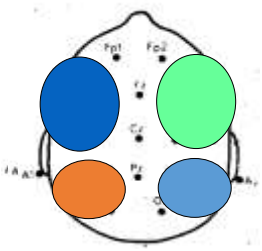
Relative Power	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	16.78	17.54	6.20	6.74
Theta	6.75	5.74	5.20	5.07
Alpha	52.21	51.97	71.04	70.79
Beta	24.24	22.74	17.56	15.40

Relative Z-score	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	-0.53	-0.55	-1.14	-0.69
Theta	-1.27	-1.02	-1.12	-1.04
Alpha	0.96	0.94	1.64	1.41
Beta	-0.12	-0.12	-0.59	-0.69









Recording Start:	11:00:29 2006-05-15	**Technologist:**	
Recording End:	11:15:45 2006-05-15	**Reference File:**	ica1.dat

Epoch Information

Start Time	Duration
2006-05-15 11:00:31	00:00:12

Absolute Power (Log)	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	1.05	0.82	1.64	1.65
Theta	2.81	2.78	3.91	3.90
Alpha	3.27	3.13	3.98	3.87
Beta	1.28	1.31	1.83	1.74

Absolute Z-score	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	-0.58	-0.69	1.09	1.99
Theta	3.74	3.61	4.08	3.71
Alpha	0.98	0.47	0.95	0.96
Beta	0.00	0.45	0.64	1.06

Relative Power	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	8.94	8.04	6.73	7.08
Theta	50.08	51.06	59.94	49.79
Alpha	29.56	26.20	26.51	33.27
Beta	11.00	14.69	6.82	9.86

Relative Z-score	Anterior		Posterior	
Band	Left	Right	Left	Right
Delta	-1.54	-1.45	-1.08	-0.76
Theta	4.62	5.64	5.67	4.86
Alpha	-0.89	-0.72	-1.22	-0.92
Beta	-1.32	-0.89	-1.41	-1.26

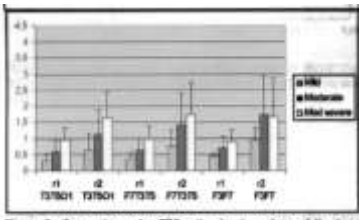
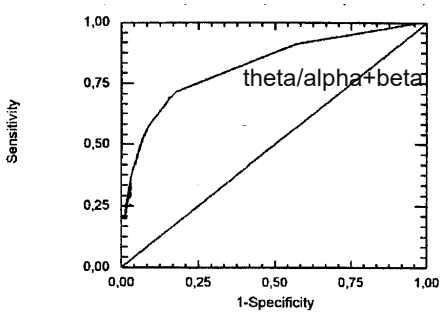


Figure 2. Comparison of q-EEG ratios in six regions of the head between subgroups of AD patients, defined according to the Global Deterioration Scale. Values are presented as mean ± SEM for each ratio. *$p < 0.05$: this significance refers to comparison between subgroups of AD patients.



Bennys et al 2001

Relationship between the cortical choline acetyltransferase content and EEG delta-power

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(Received 30 August 1989; Revised version received 6 October 1989; Accepted 8 December 1989)

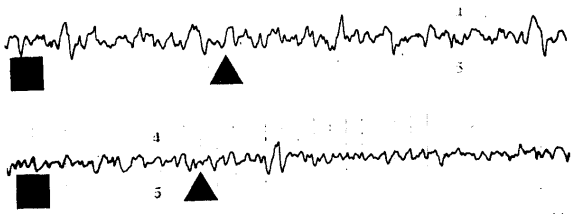
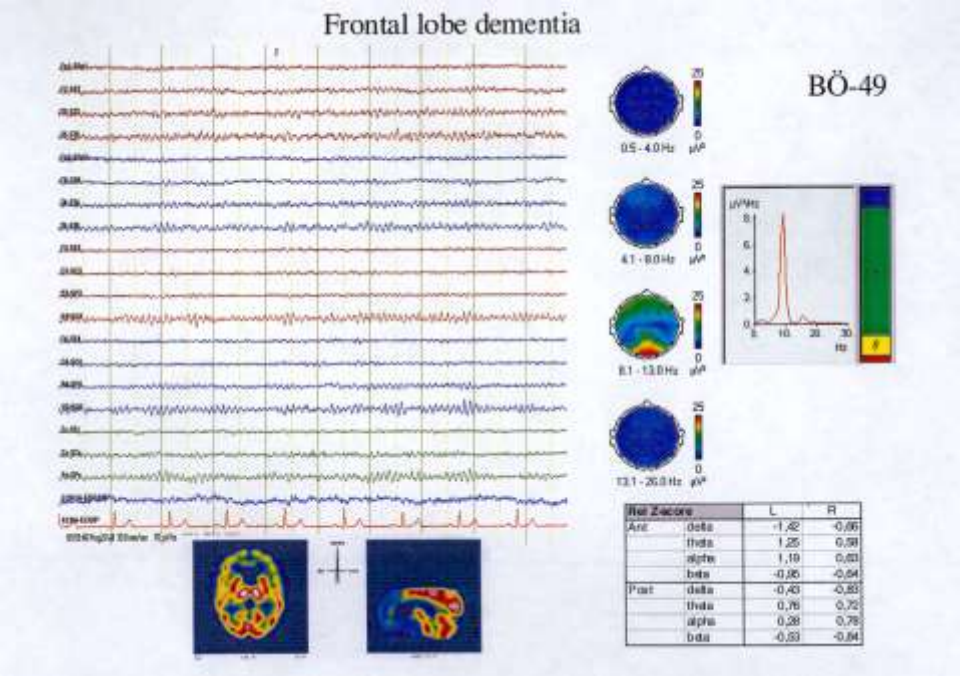


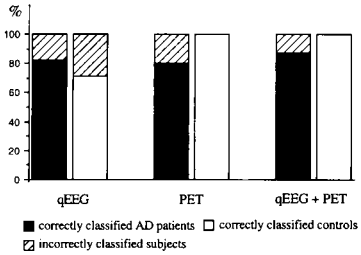
Fig. 3. Frontal EEG activity from a lesioned (top) and a control (bottom) rat during waking immobility. Duration of the epoch shown is 8 s. Scale triangle indicates 0.5 s; scale square indicates 300 μV.

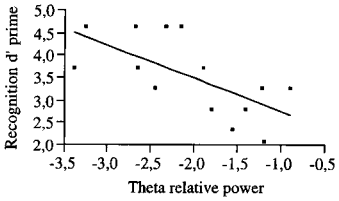


qEEG vid AD

- Återspeglar grad av demens
- Korrelerar med atrofi och SPECT/PET abnormitet
- Continuum Nold > MCI- > MCI+ > AD
- Apo-E4 MCI/AD har mer uttalade förändringar
- Korrelerar med cholinerg defekt
- Påverkas av chei-behandling

	AD patients n= 40	Healthy controls n= 14
qEEG	False classifications= 7	False classifications=4
PET	False classifications= 8	False classifications=0





Normal controls (n=14)

VI

Jelic 1999

Mentis cura

Statistical pattern recognition SPR

Classifiers constructed for each possible pair of groups (20 features)

Table 2. EEG features used for the classifiers.

Spectral feature	Description
1	Power in the δ frequency band (0.5 – 3.5 Hz)
2	Power in the θ frequency band (3.5 – 7.5 Hz)
3	Power in the α_1 frequency band (7.5 – 9.5 Hz)
4	Power in the α_2 frequency band (9.5 – 12.5 Hz)
5	Power in the β_1 frequency band (12.5 – 17.5 Hz)
6	Power in the β_2 frequency band (17.5 – 25 Hz)
7	Power in the γ frequency band (25 – 40 Hz)
8	Relative power in the δ frequency band
9	Relative power in the θ frequency band
10	Relative power in the α_1 frequency band
11	Relative power in the α_2 frequency band
12	Relative power in the β_1 frequency band
13	Relative power in the β_2 frequency band
14	Relative power in the γ frequency band
15	Total power of the EEG power spectrum (0.5 – 40 Hz)
16	Peak α frequency
17	Median frequency of the EEG power spectrum
18	Power ratio : $\theta/(\alpha_1+\alpha_2+\beta_1)$
19	Power ratio : $(\delta+\theta)/(\alpha_1+\alpha_2+\beta_1+\beta_2)$
20	Power ratio : $\theta/(\alpha_1+\alpha_2)$

Columnwise evaluated for each spectral feature

	For interhemispheric
1-10	Fp1/O1, Fp2/O2, Fp1/P3, Fp2/P4, F3/O1, F4/O2, F3/P3, F4/P4, C3/O1, C4/O2
	For interhemispheric
11-17	F7/F8, F3/F4, T3/T4, C3/C4, T5/T6, P3/P4, O1/O2
	Local anterior
18-27	Fp1/F7, Fp2/F8, Fp1/F3, Fp2/F4, F7/C3, F8/C4, F7/T3, F8/T4, F3/C3, F4/C4
	Local posterior
28-37	T5/O1, T6/O2, P3/O1, P4/O2, C3/T5, C4/T6, P3/C3, P4/C4, P3/T5, P4/T6

Table 1. The composition of groups used in the construction of the classifiers presented in this article. The description of each group is in the text of the article. The age is presented as: mean age ± standard deviation of the age distribution.

	N	Age (years)
ARM	226	65 ± 9
AD	238	78 ± 6
VaD	58	76 ± 7
vMCI	41	73 ± 8
DLBP	52	76 ± 7
FLD	14	73 ± 10
DPR	24	75 ± 7
Total	654	70 ± 8

1120 features/EEG recording

Table 3. The area under curve (accuracy, sensitivity specificity) and nomenclature of classifiers and groups. The accuracy, sensitivity, and specificity is based on a decision point at index value equal to 0.5 for each classifier and evaluated using 10-fold cross validation. All numbers are percentages.

	NRM	AD	VaD	sMCI	DLBP	FLD	DFR
NRM		93 (88,83/98)	93 (88,86/98)	87 (80,80/88)	99 (97,98/95)	92 (87,92/83)	89 (83,82/85)
AD	NRM-AD		80 (75 ,77/71)	88 (80 ,75/93)	97 (91 ,83/98)	93 (88 ,82/93)	79 (73,66/75)
VaD	NRM-VaD	AD-VaD		89 (84 ,81/78)	94 (87 ,88/87)	87 (80 ,74/87)	86 (78 ,84/72)
sMCI	NRM-sMCI	AD-sMCI	VaD-sMCI		98 (95,93/98)	93 (83 ,87/80)	85 (78 ,76/80)
DLBP	NRM-DLBP	AD-DLBP	VaD-DLBP	sMCI-DLBP		96 (93 ,98/99)	98 (93 ,92/94)
FLD	NRM-FLD	AD-FLD	VaD-FLD	sMCI-FLD	DLBP-FLD		86 (80 ,86/84)
DFR	NRM-DFR	AD-DFR	VaD-DFR	sMCI-DFR	DLBP-DFR	FLD-DFR	

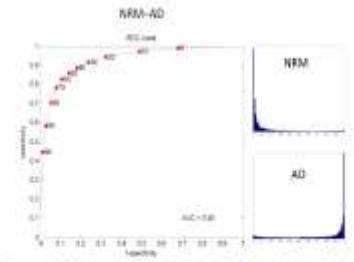


Figure 1. The ROC curve for the NRM-AD classifier. The small frames show the distributions of classification indices resulting from a 10-fold cross validation for each of the two groups NRM and AD. The accuracy, sensitivity, and specificity of the classifier are listed in table 3. AUC is the Area Under the Curve.

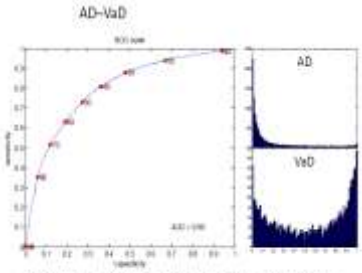
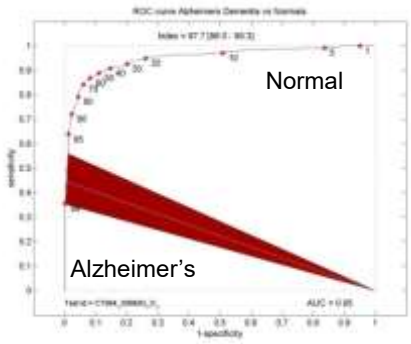


Figure 2. The ROC curve for the AD-VaD classifier. The small frames show the distributions of classification indices resulting from a 10-fold cross validation for each of the two groups AD and VaD. The accuracy, sensitivity, and specificity of the classifier are listed in table 3. AUC is the Area Under the Curve.

Mentis Cura Alz-Index

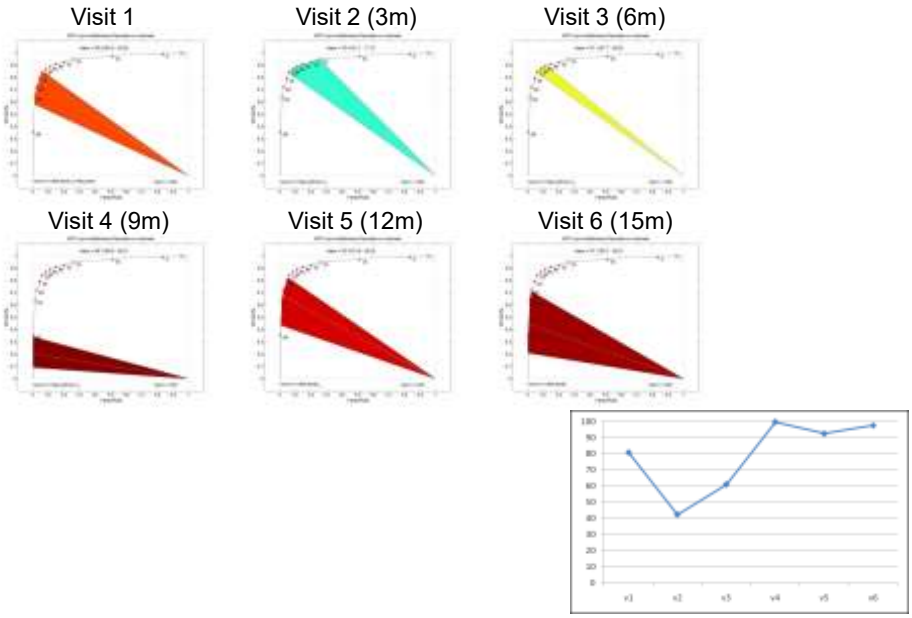


The Alz-Index is based on EEG recordings and database supported diagnostics.

Multivariate statistical comparison of the features of the EEG against a database of features from Normal and Alzheimer's subjects.

Index range : [0-100] ([Norm-Alz])

Longitudinal : S1



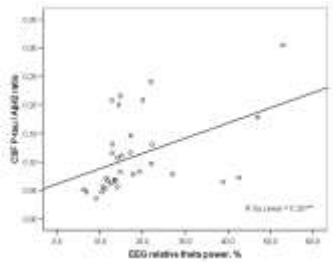


Table 3

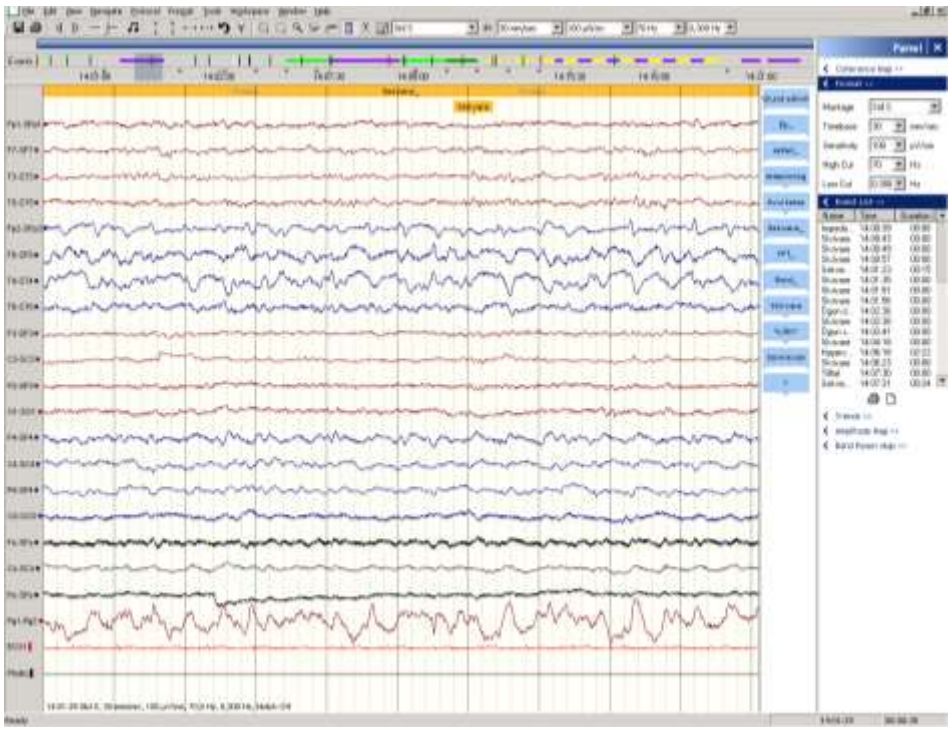
Spearman rank correlation coefficient for correlation of EEG frequencies and CSF biomarkers

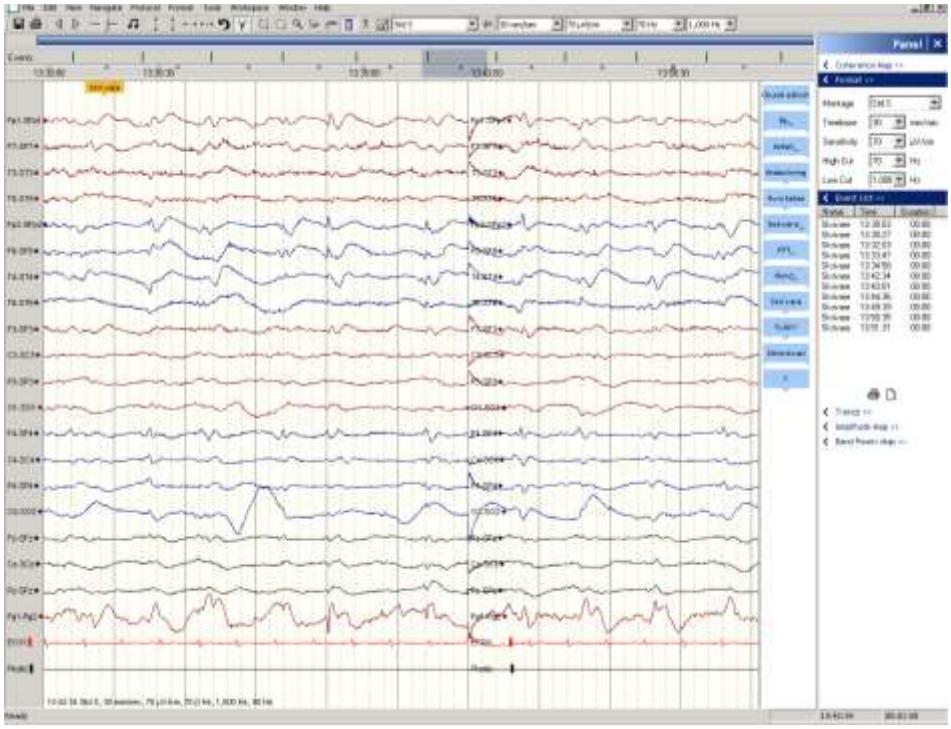
	CSF biomarkers				
EEG	T-tau, ng/l	P-tau, ng/l	$A\beta_{1-42}$, ng/l	P-tau/$A\beta_{1-42}$	T-tau/$A\beta_{1-42}$
Mean peak frequency	-0.234	-0.256	0.109	-0.303	-0.239
Relative power - Delta	0.113	0.167	0.089	0.152	0.137
Relative power - Theta	0.545**	0.556**	-0.178	0.622***	0.575**
Relative power - Alpha	-0.38	-0.105	0.094	-0.167	-0.132
Relative power - Beta	-0.120	-0.068	0.181	-0.193	-0.196

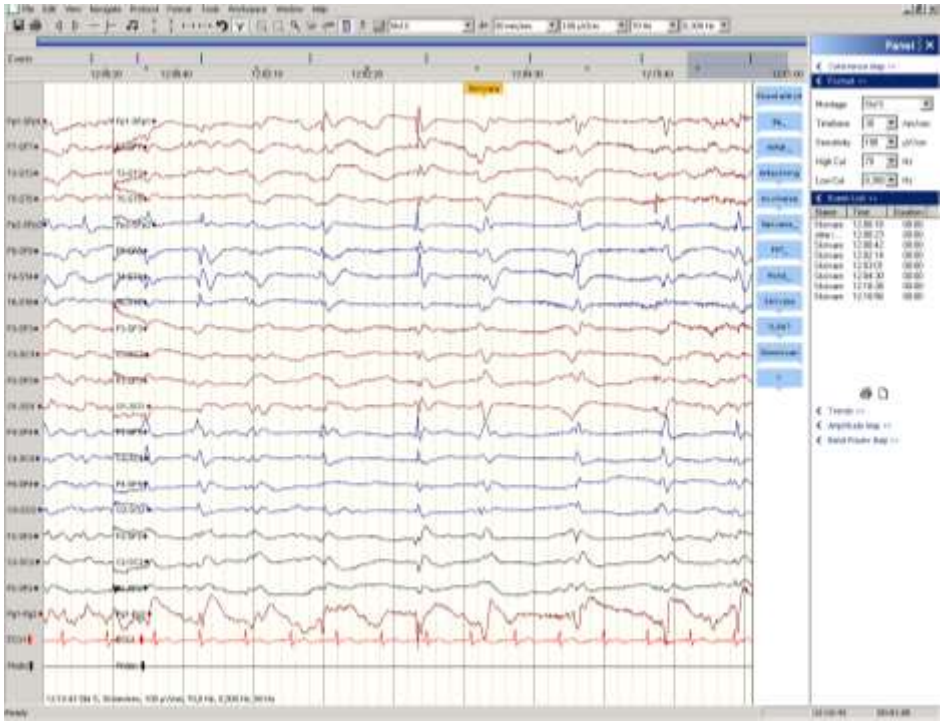
** p <0.01, *** p <0.001

Stomrud et al. Neurobiol of aging 2008

F 67 yo
Slight dystonia left arm since 2 weeks
Cognitive deterioration
Agressive
Diffuse visual symptoms







The diagnostic criteria for probable sCJD are:

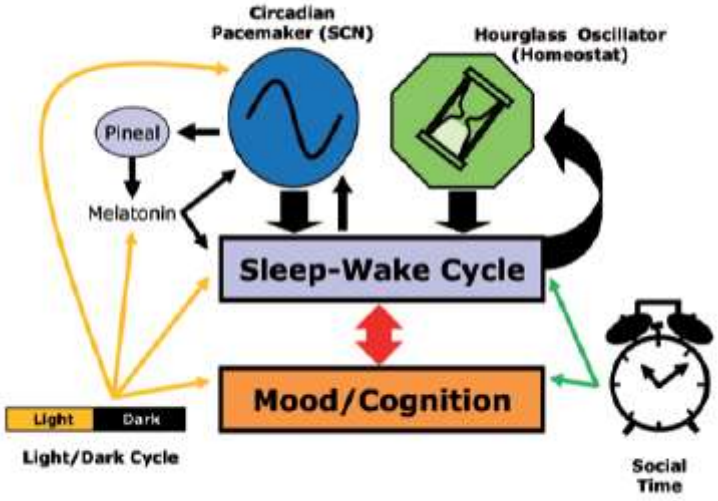
(1)rapidly evolving dementia (<2 years),

(2) typical PSWC with triphasic morphology in EEG recordings and/or presence of 14-3-3 protein in cerebrospinal fluid (CSF) examination, and

(3) at least two of the following 4 clinical signs: (a) myoclonia, (b) ataxia and/or visual signs and symptoms, (c) extrapyramidal and/or pyramidal signs and symptoms, and (d) akinetic mutism.

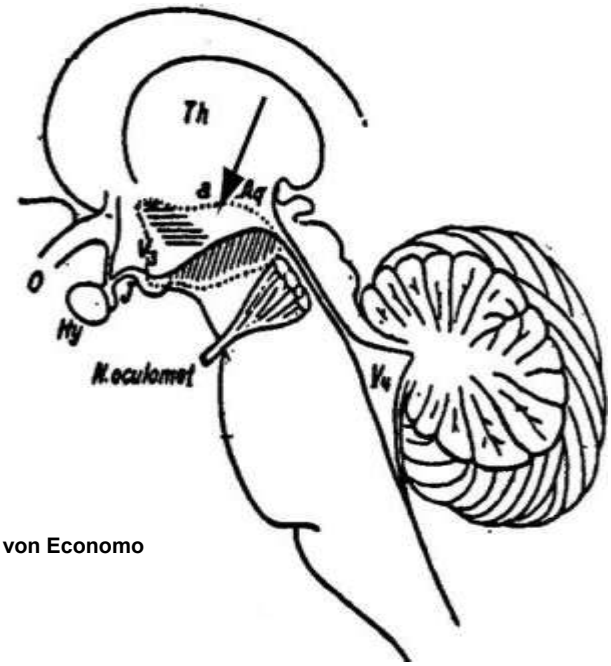
Patients with the clinical signs of sCJD but without the EEG and CSF abnormalities (either not present or investigation not available) are classified as possible sCJD.

SÖMN

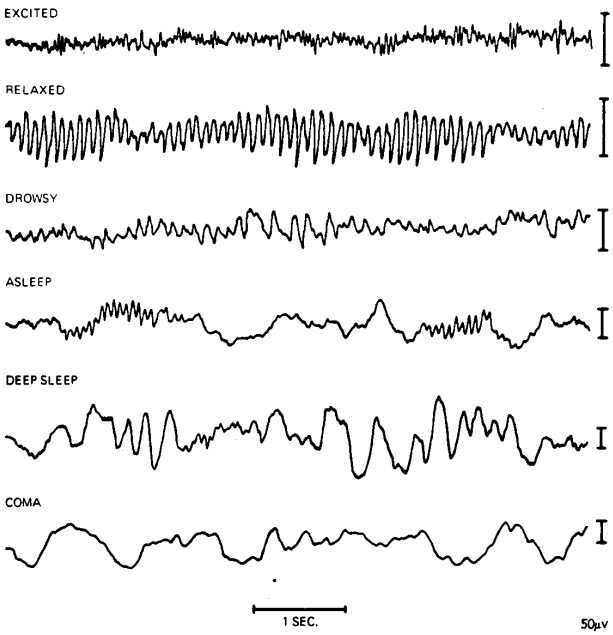


Viktiga upptäckter kring sömn

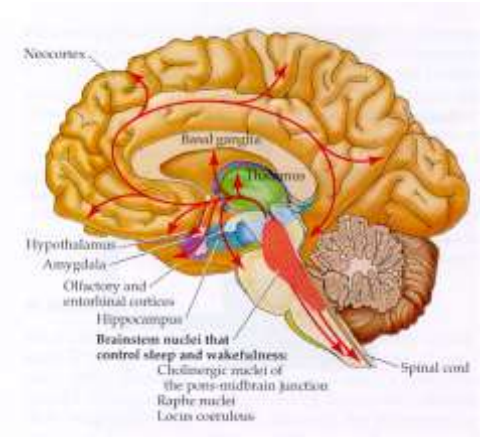
- **Skador på hypothalamus ger sömnstörning**
- **Olika sömnstadier uppvisar olika EEG-mönster**
- **Det retikulära aktiverings-systemet (RAS) i hjärnstammen**
- **REM-sömn**
- **Den homeostatiska sömn-regleringen**
- **Orexin/hypokretinsystemet och narkolepsi**
- **SCN och den interna dygnsrytmen**
- **Melatonin**
- **Sömn och minne >++**
- **Sömnstörning som tidigt förebud om alfa-synucleinopati-relaterad demensutveckling**



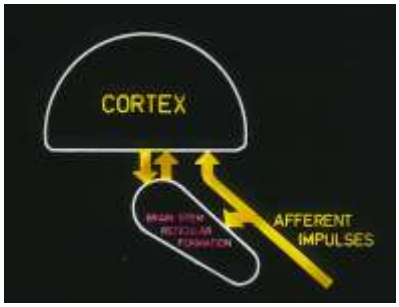
von Economo

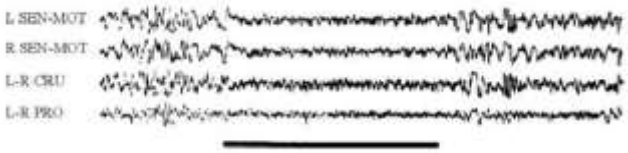


Berger



Reticular Activating System (RAS)





Moruzzi, Magoun 1949

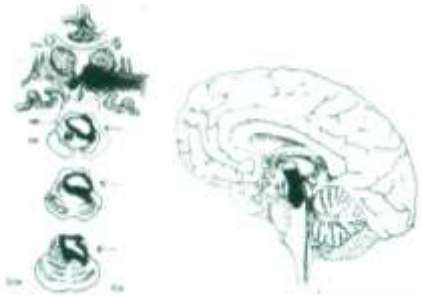
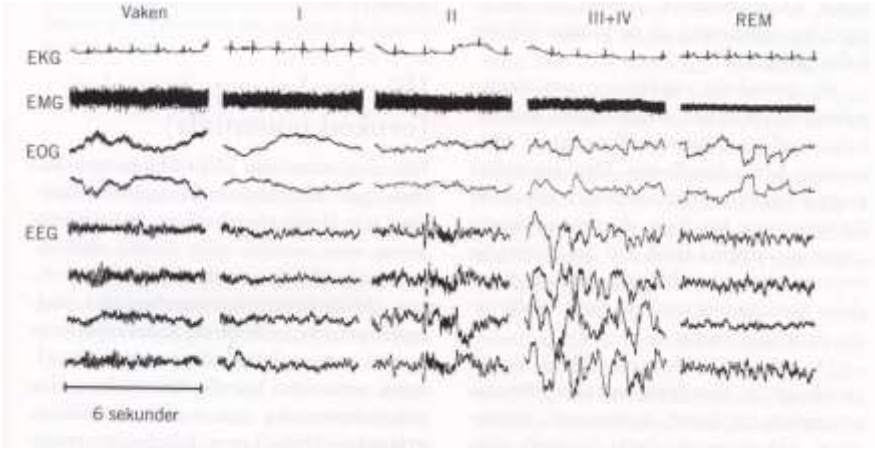
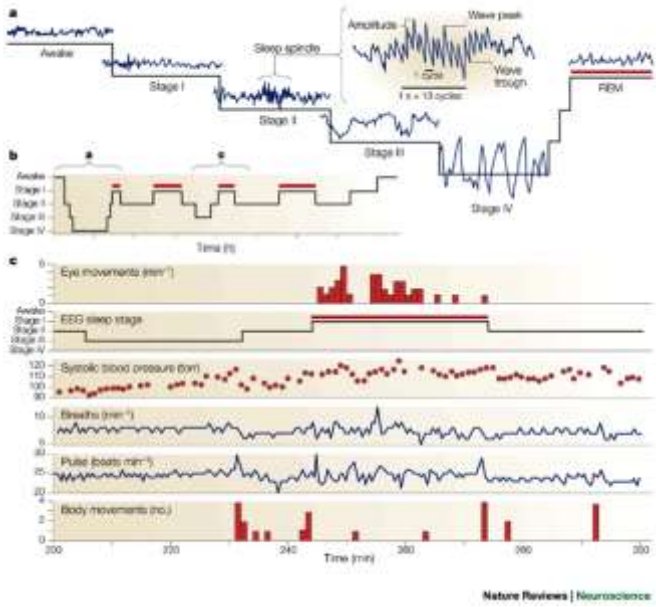
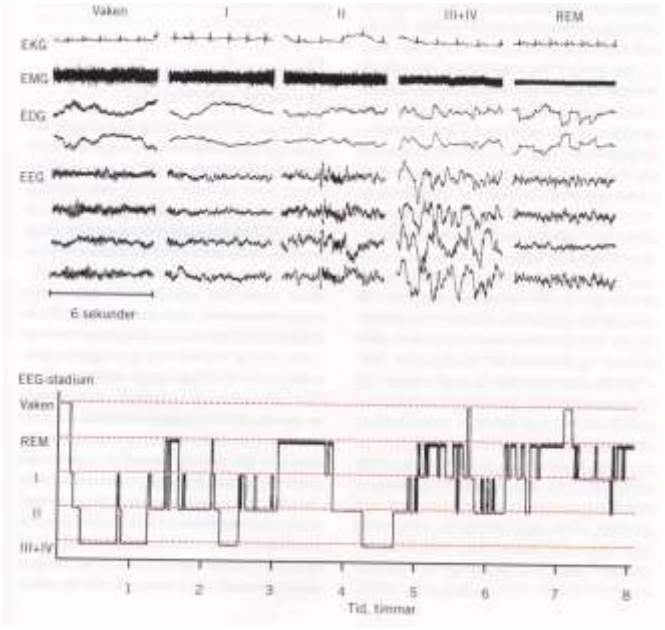


Fig 1.—EEG sample (anteroposterior leads), eight months following admission.



Kleitman Aserinski



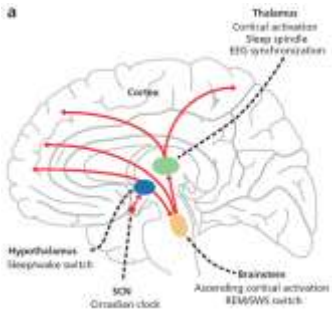


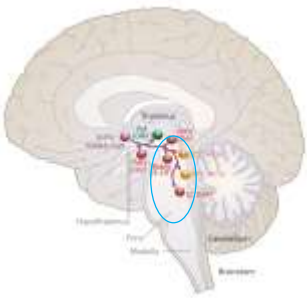
Rechtschaffen, Kales

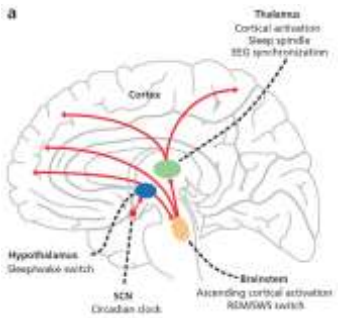
Vaken: Ach , NA , DA , 5-HT

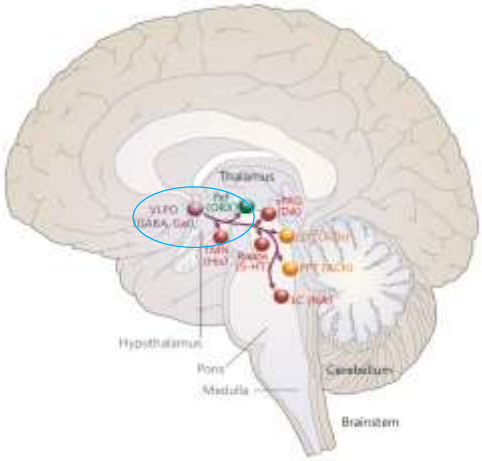
Non-REM : Ach , NA , DA , 5- HT

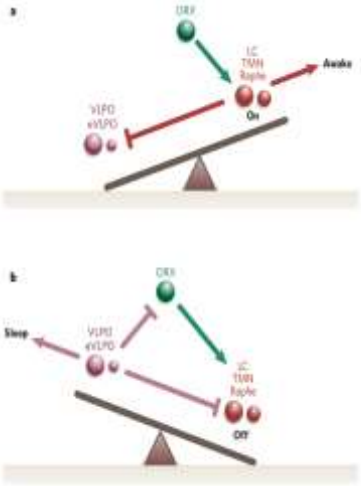
REM: ACH , NA , DA , 5-HT

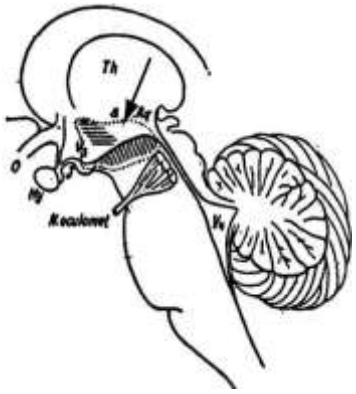


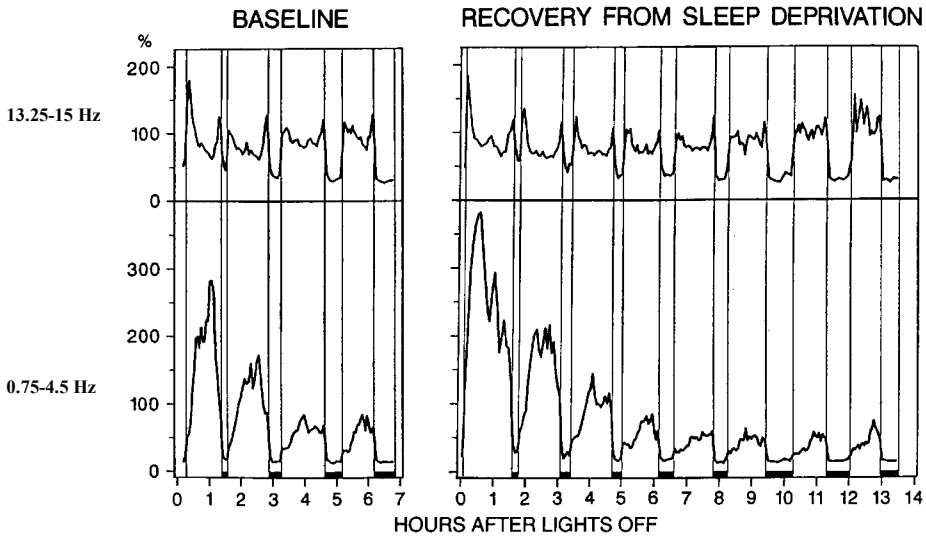



a
Thalamus
Cortical activation
Sleep spindle
EEG synchronization
Cortex
Hypothalamus
Sleep/wake switch
SCN
Circadian clock
Brainstem
Ascending cortical activation
REM/SWS switch

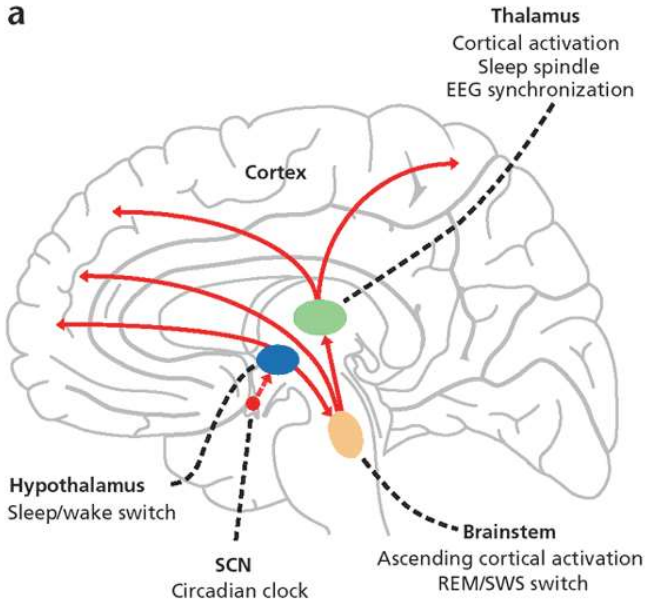

Thalamus
Hypothalamus
Pons
Medulla
Cerebellum
Brainstem

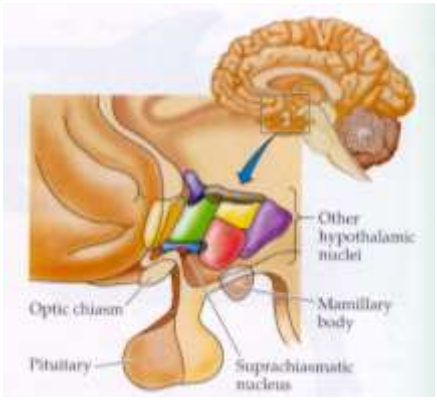

a
ORX
LC
TMN
Raphe
Awake
On
VLPO
eVLPO
b
ORX
Sleep
VLPO
eVLPO
LC
TMN
Raphe
Off

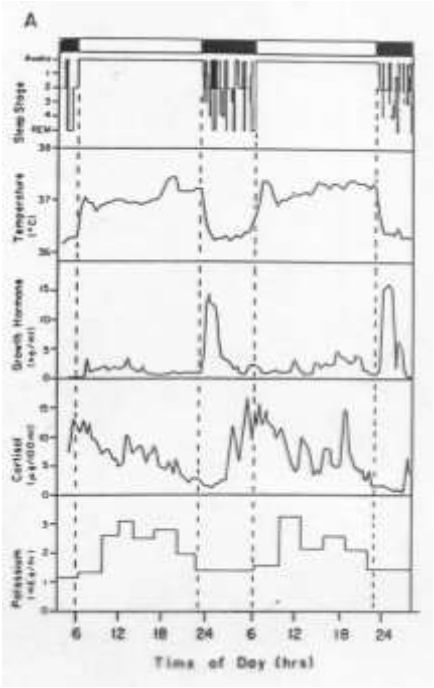

Th
Mo
Masseter

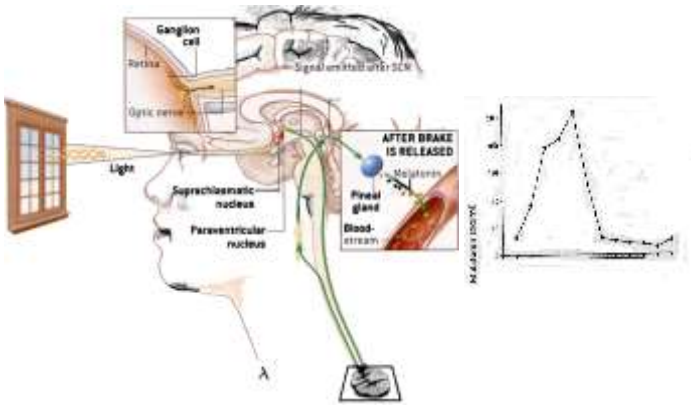

BASELINE
RECOVERY FROM SLEEP DEPRIVATION
%
13.25-15 Hz
0.75-4.5 Hz
200
100
0
300
200
100
0
0 1 2 3 4 5 6 7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
HOURS AFTER LIGHTS OFF

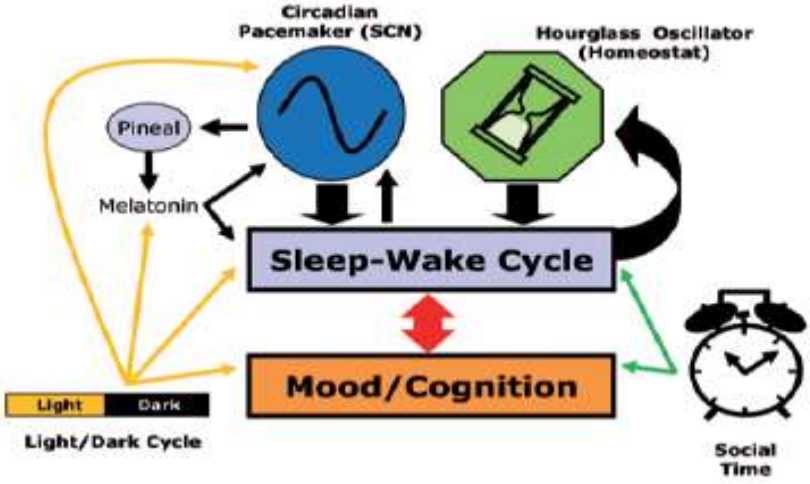
Adenosin ?

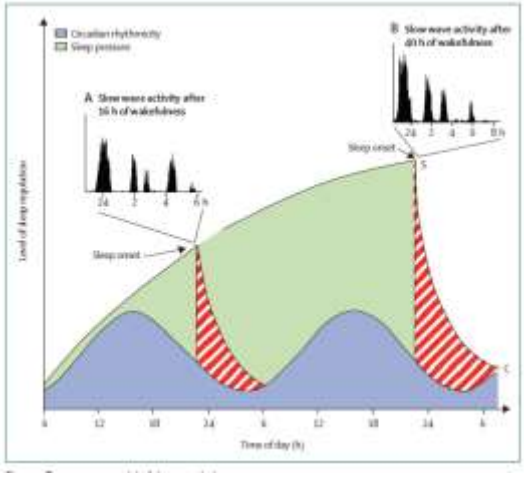

a
Thalamus
Cortical activation
Sleep spindle
EEG synchronization
Cortex
Hypothalamus
Sleep/wake switch
SCN
Circadian clock
Brainstem
Ascending cortical activation
REM/SWS switch

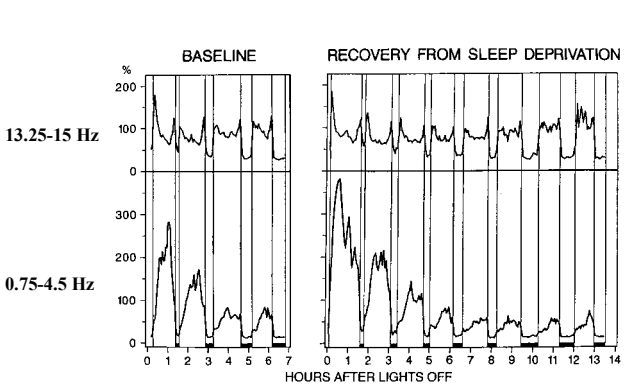

Other hypothalamic nuclei
Optic chiasm
Mamillary body
Pituitary
Suprachiasmatic nucleus

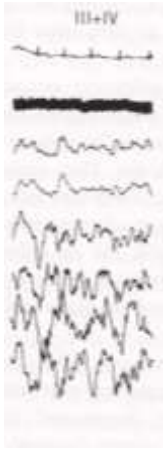

A
Sleep Stage
Temperature (°C)
Growth Hormone (ng/ml)
Cortisol (μg/100ml)
Potassium (mEq/liter)
6
12
18
24
6
12
18
24
Time of Day (hrs)

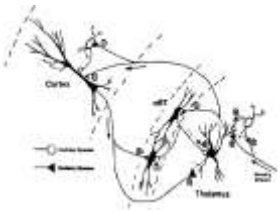

Ganglion cell
Retina
Optic nerve
Signal is relayed to SCN
Light
Suprachiasmatic nucleus
Paraventricular nucleus
AFTER BRAKE IS RELEASED
Melatonin
Pineal gland
Blood-stream
A


Circadian
Pacemaker (SCN)
Hourglass Oscillator
(Homeostat)
Pineal
Melatonin
Sleep-Wake Cycle
Mood/Cognition
Light
Dark
Light/Dark Cycle
Social
Time

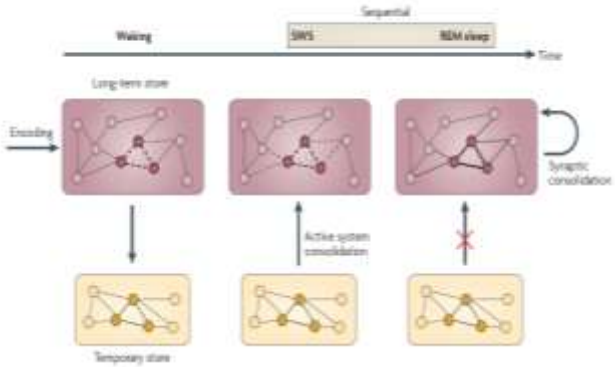


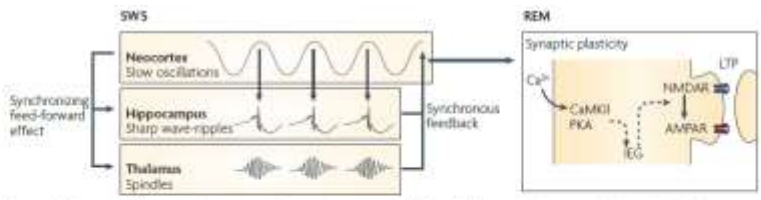

BASELINE
RECOVERY FROM SLEEP DEPRIVATION
13.25-15 Hz
0.75-4.5 Hz
%
HOURS AFTER LIGHTS OFF

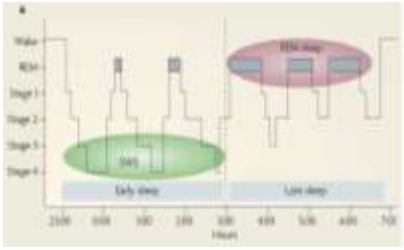


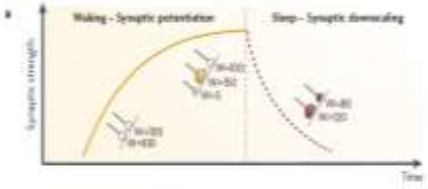


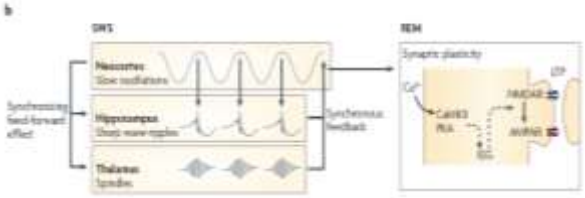

ASLEEP

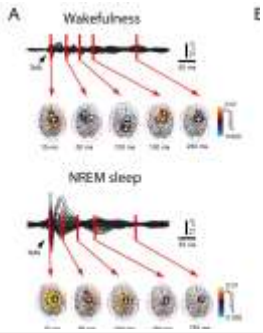

Waking
SWS
REM sleep
Time
Long-term store
Encoding
Synaptic consolidation
Active system consolidation
Temporary store

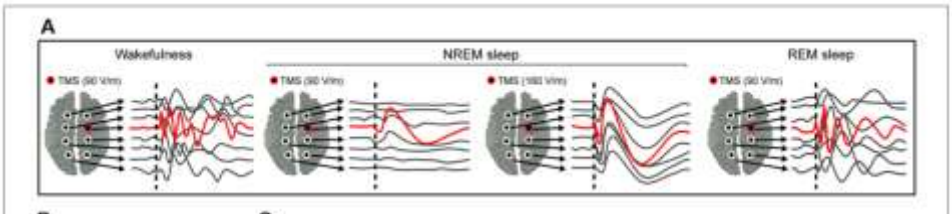

SWS
REM
Neocortex
Slow oscillations
Hippocampus
Sharp wave-ripples
Thalamus
Spindles
Synchronizing feed-forward effect
Synchronous feedback
Synaptic plasticity
LTP
NMDAR
CaMKII
PKA
AMPAR

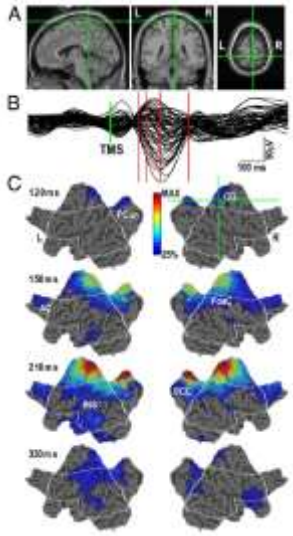

Wake
REM
Stage 1
Stage 2
Stage 3
Stage 4
SWS
Early sleep
Late sleep

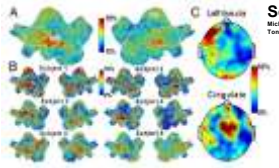

a
Waking – Synaptic potentiation
Sleep – Synaptic downscaling
Synaptic strength
Time


b
SWS
REM
Neocortex
Slow oscillations
Hippocampus
Sharp-wave ripples
Thalamus
Spindles
Synchronous feed-forward effect
Synchronous feedback
Synaptic plasticity
Ca2+
CaMKII
PKA
AMPAR
LTP


A
Wakefulness
NREM sleep


A
Wakefulness
NREM sleep
REM sleep
TMS (90 V/m)
TMS (90 V/m)
TMS (100 V/m)
TMS (90 V/m)



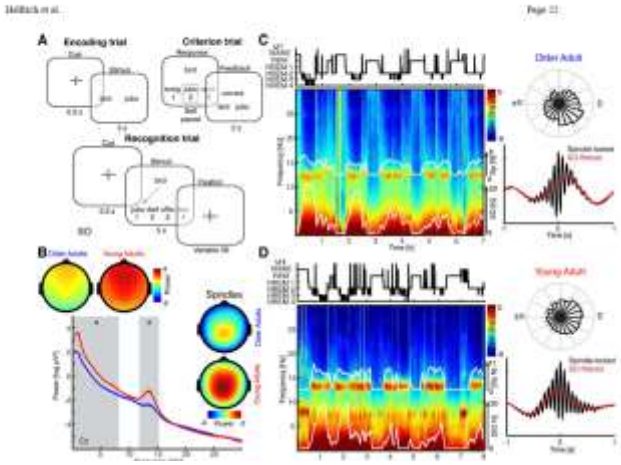


Source modeling sleep slow waves

Michael Murphy , Brady A. Riedner , Reto Huber, Marcello Massimini, Fabio Ferrarelli, and Giulio Tononi.

Slow waves are the most prominent electroencephalographic (EEG) feature of sleep. These waves arise from the synchronization of slow oscillations in the membrane potentials of millions of neurons. Scalp-level studies have indicated that slow waves are not instantaneous events, but rather they travel across the brain. Previous studies of EEG slow waves were limited by the poor spatial resolution of EEGs and by the difficulty of relating scalp potentials to the activity of the underlying cortex. Here we use high-density EEG (hd-EEG) source modeling to show that individual spontaneous slow waves have distinct cortical origins, propagate uniquely across the cortex, and involve unique subsets of cortical structures. However, when the waves are examined en masse, we find that there are diffuse hot spots of slow wave origins centered on the lateral sulci. Furthermore, slow wave propagation along the anterior–posterior axis of the brain is largely mediated by a cingulate highway. As a group, slow waves are associated with large currents in the medial frontal gyrus, the middle frontal gyrus, the inferior frontal gyrus, the anterior cingulate, the precuneus, and the posterior cingulate. These areas overlap with the major connectional backbone of the cortex and with many parts of the default network.

Neuron. 2018 January 03; 97(1): 221–230

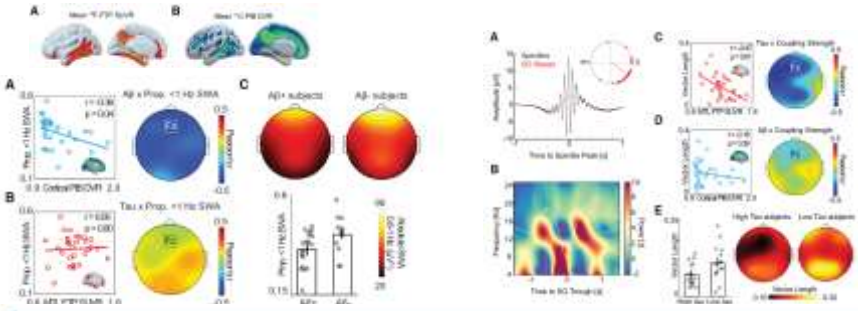


Highlights

Precise coupling of NREM slow waves and spindles dictates memory consolidation.

Aging impairs slow wave-spindle coupling, leading to overnight forgetting.

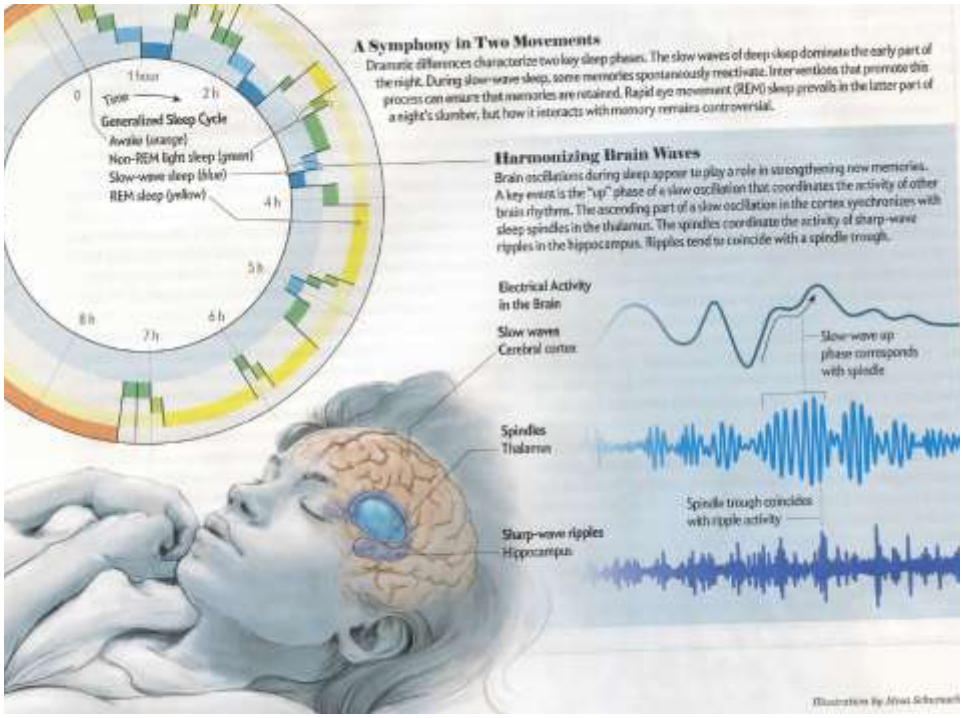
Age-related atrophy in mPFC predicts the failure of such coupling and thus memory.

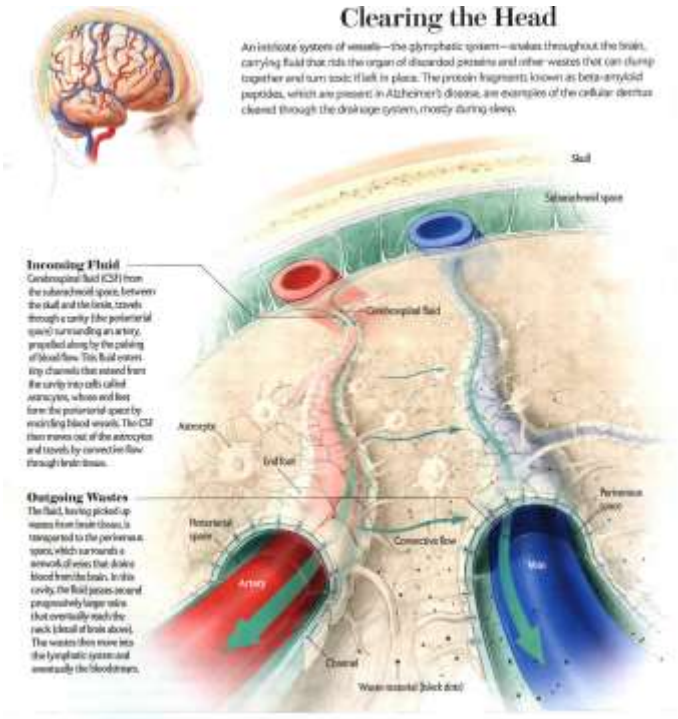


The Journal of Neuroscience, August 7, 2019 .39(32):6315– 6324 • **6315**

Significance Statement

Several studies have linked sleep disruption to the progression of Alzheimer's disease (AD). Tau and β-amyloid (Aβ), the primary pathological features of AD, are associated with both objective and subjective changes in sleep. However, it remains unknown whether late life tau and Aβ burden are associated with distinct impairments in sleep physiology or changes in sleep across the lifespan. Using polysomnography, retrospective questionnaires, and tau- and Aβ-specific PET, the present study reveals human sleep signatures that dissociably predict levels of brain tau and Aβ in older adults. These results suggest that a night of polysomnography may aid in evaluating tau and Aβ burden, and that treating sleep deficiencies within decade-specific time windows may serve in delaying AD progression.

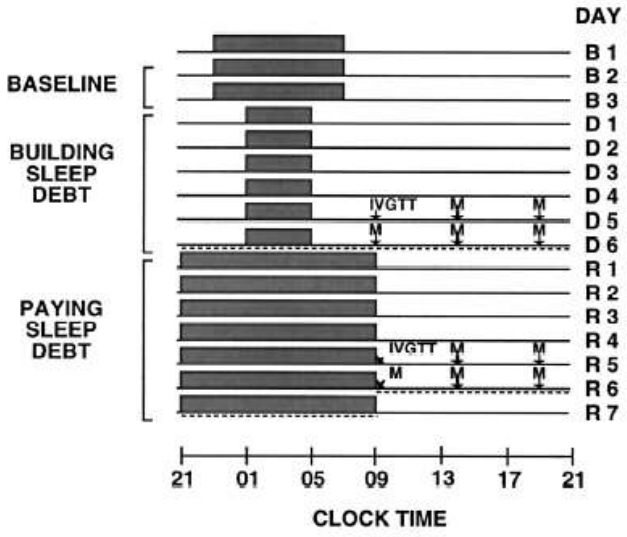




Effekt av sömndeprivation

- 11 unga friska män studerades under 6 nätters sömnrestriktion (4 timmar) följt av 6 nätter med 12 timmar i sängen.
- Sömn, kolhydratomsättning, thyreotropa funktionen, HPA funktion, Symp/vagal balans(RR analys) Antikroppssvar på influensavaccination.

Van Cauter



Van Cauter

Resultat

- Glucose toleransen försämrades
- Kvälls-cortisol nivåerna ökade
- Thyreotropin-insöndringen minskade
- Sympaticus-tonus ökade
- Leptin-nivåerna minskade
- Antikroppssvaret på influensavaccination sämre hos den sömndepriverade gruppen.
- Förändringarna restituerades genom fri sömn.

Van Cauter

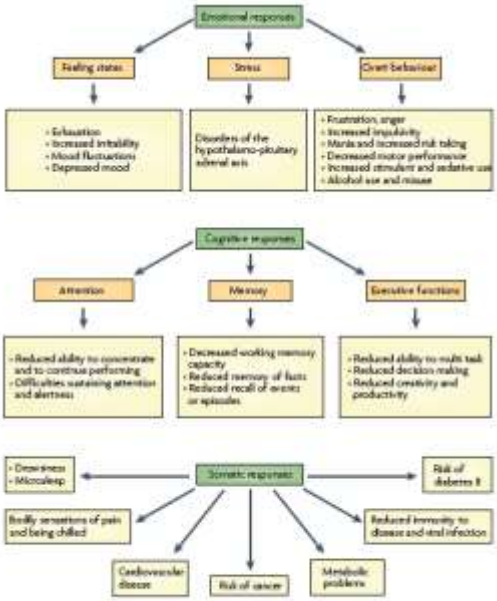
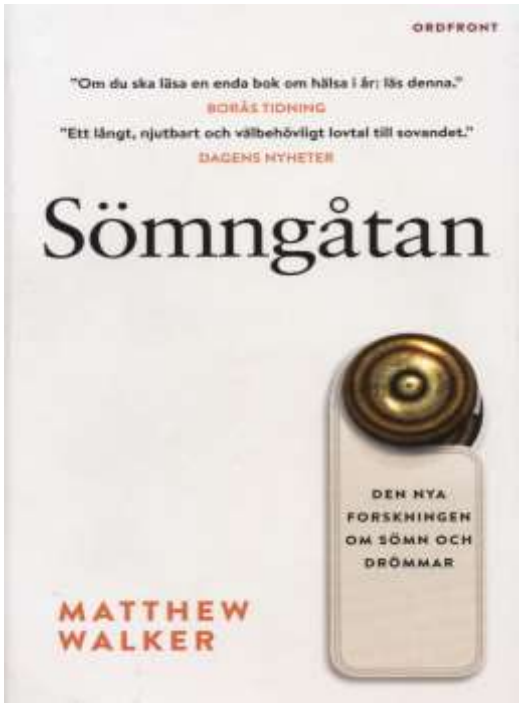


Figure 2 | **The health consequences of shortened or reduced sleep and desynchronized circadian rhythms, classified by emotional, cognitive and somatic responses.** For a full list and references see Supplementary information S3 (table).



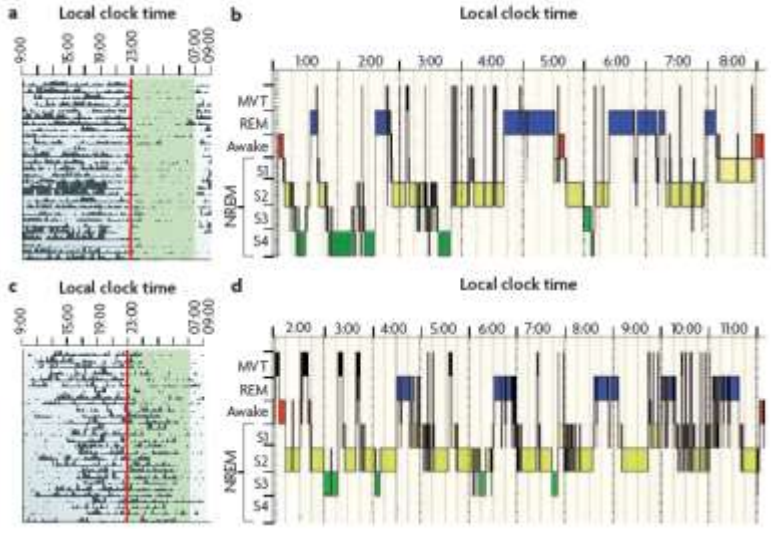
Sömnklinik

- Dagsömnighet (OSAS, Narkolepsi, insomni)
- Abnorma sömnfenomen (OSAS,PLM, somnambulism, epilepsi, REM-relaterat abnormt beteende), Frontallobs-epilepsi
- Insomnings-problem (psykogent, RLS)
- Dygnsrytm-rubbning (jet-lag, störd 24 tim rytm)

Sömn-anamnes/Sömndagbok ofta diagnostisk

Sömnundersökningar

- Ambulatorisk apné-test
- Polygrafisk helnatts- sömnregistrering
- MSLT
- Aktigrafisk registrering



Sömnattacker
Kataplexi
Sömnhallucinos
Sömnparalys

Narkolepsi

- Sömn-attacker (obs sömnighet inte trötthet)
- Kataplektiska attacker
- Sömn-paralys
- Hypnagoga/hypopompiska hallucinationer visuella vanligare än auditiva
- Insomni, frekventa nattliga uppvakanden

Narkolepsi

- Anamnes
- MSLT
  - (5x20 min naps)
  - Sömnlatens (medelv <8 min)
  - 2 SOREM (lat efter insomn <15 min) eller REM inom 20 min
- Rek PSG natten innan (US rek >6 tim sömn natten innan) Andra orsaker exkluderas
- HLA-typning (HLA-varianten DRB1*15:01; DQB1*06:02 är ärftlig och medför en viss ökad sannolikhet att få narkolepsi.)
- Orexin/Hypocretin i CSF kommer