Funciones cognitivas del sueño

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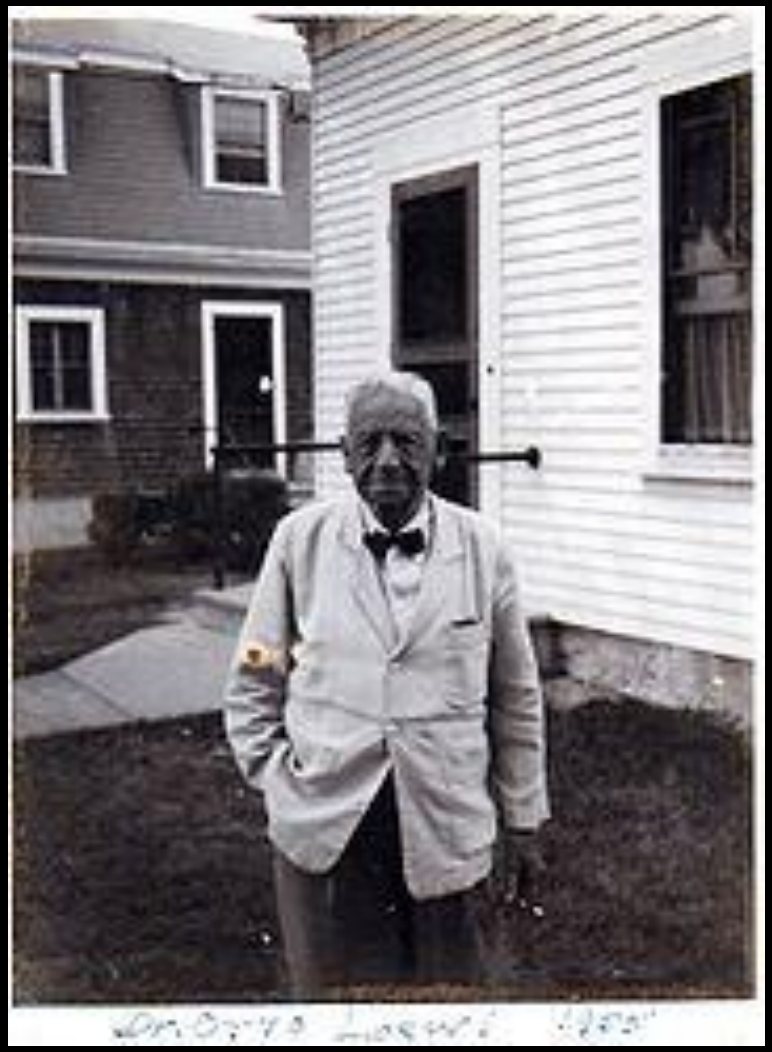
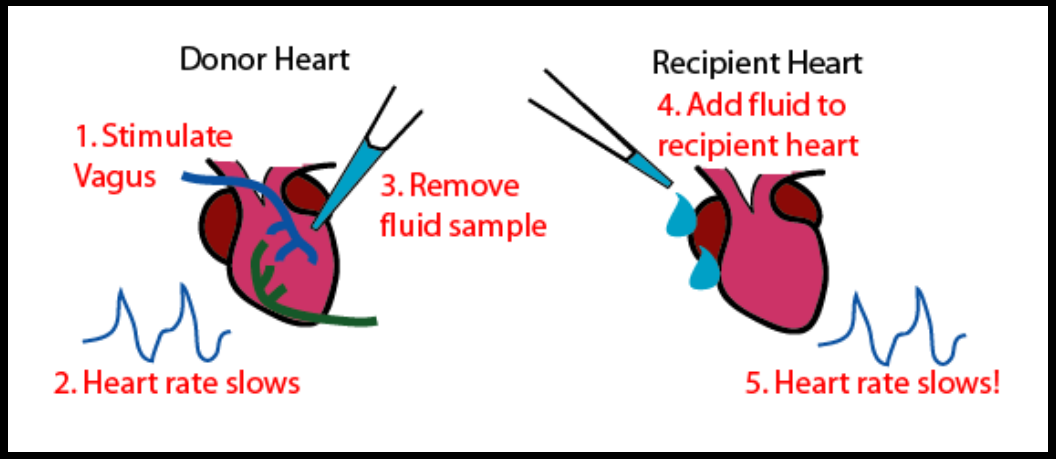
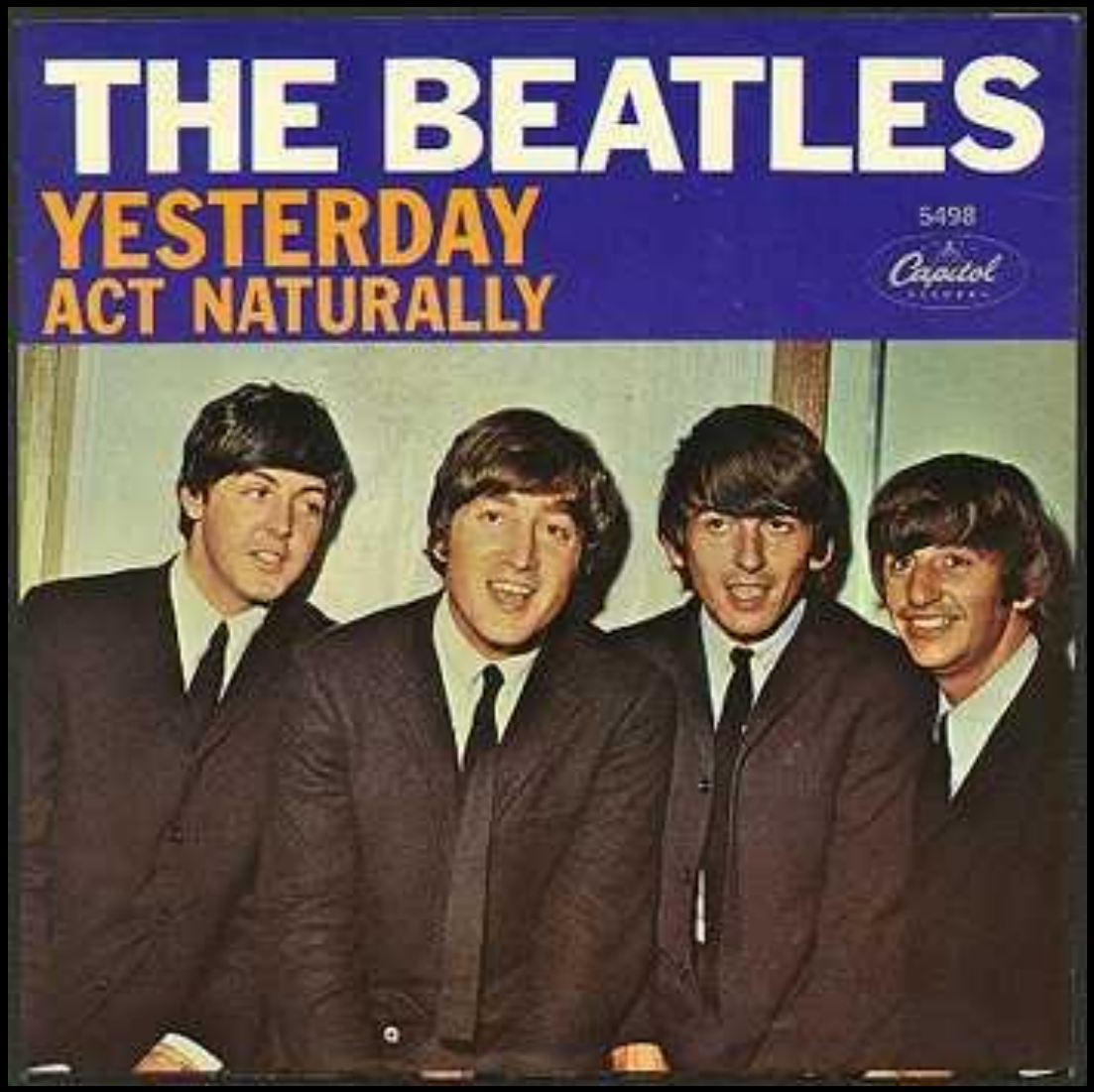
“Sobre la ciudad”. Marc Chagall



Otto Loewi. Premio Nobel en Fisiología y Medicina, 1936



"According to Loewi, the idea for his key experiment came to him in his sleep…"

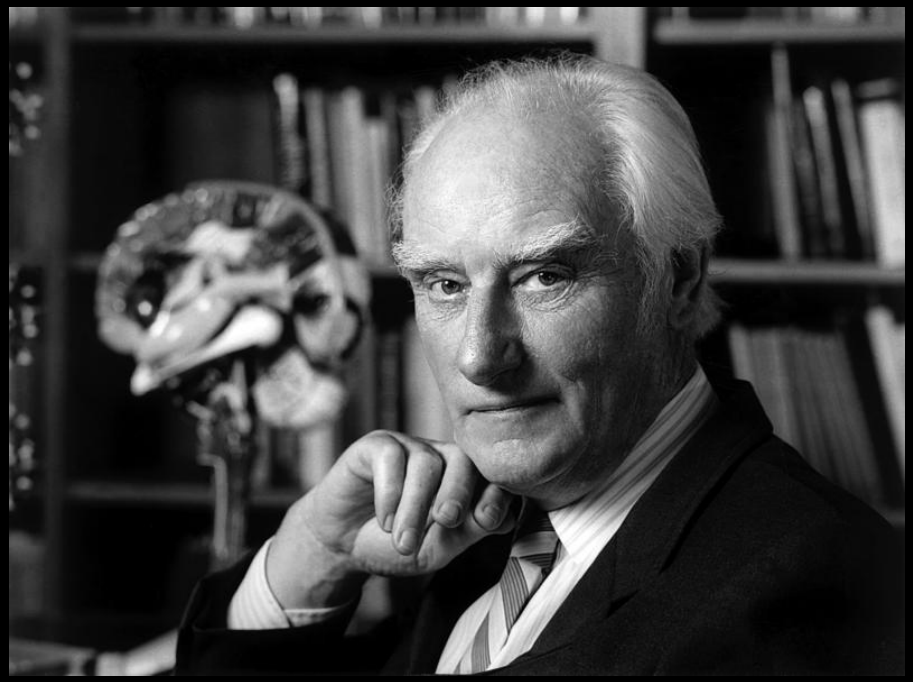


Yesterday.

“… McCartney composed the entire melody in a dream one night in his room… Upon waking, he hurried to a piano and played the tune to avoid forgetting it…”

Estudio neurobiológico de la conciencia

“El estudio de la conciencia es la búsqueda del santo grial de la neurociencia moderna”
Editorial de Nature



Francis Crick. Premio Nobel en Fisiología y Medicina, 1962

Gerald Edelman. Premio Nobel en Fisiología y Medicina, 1971

“Every one knows what **consciousness** is: it is what abandons you every evening when you fall asleep and reappears the next morning when you wake up.”
G. Edelman

“Everyone has a rough idea of what is meant by **consciousness**. It is better to avoid a precise definition of consiousness because of the danger of premature definition.”
F. Crick

- Bien orientado en tiempo y espacio.
- Somnoliento, desorientado, confuso, etc.
- Coma.

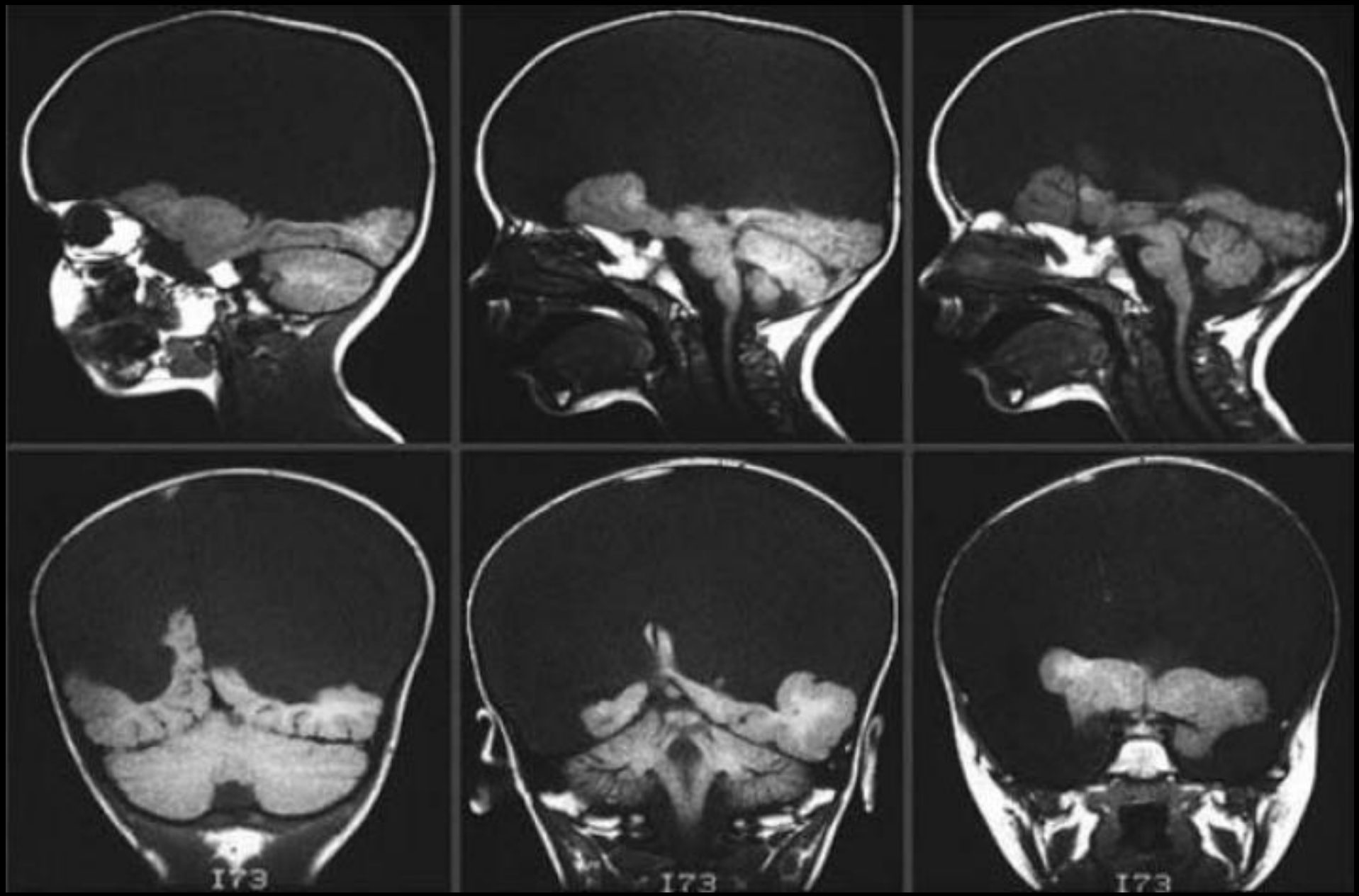
-**Correlato neural de la conciencia.**

(áreas y actividades neurales de la que emergería la actividad subjetiva de la conciencia)

-“**Hard Problem**” de Chalmers. Incapacidad para explicar con terminos cientificos el fenómeno subjetivo de la conciencia.

”…the thalamo-cortical system is ultimately responsible for the generation of consciousness" Rodolfo Llinas

Anencefalia

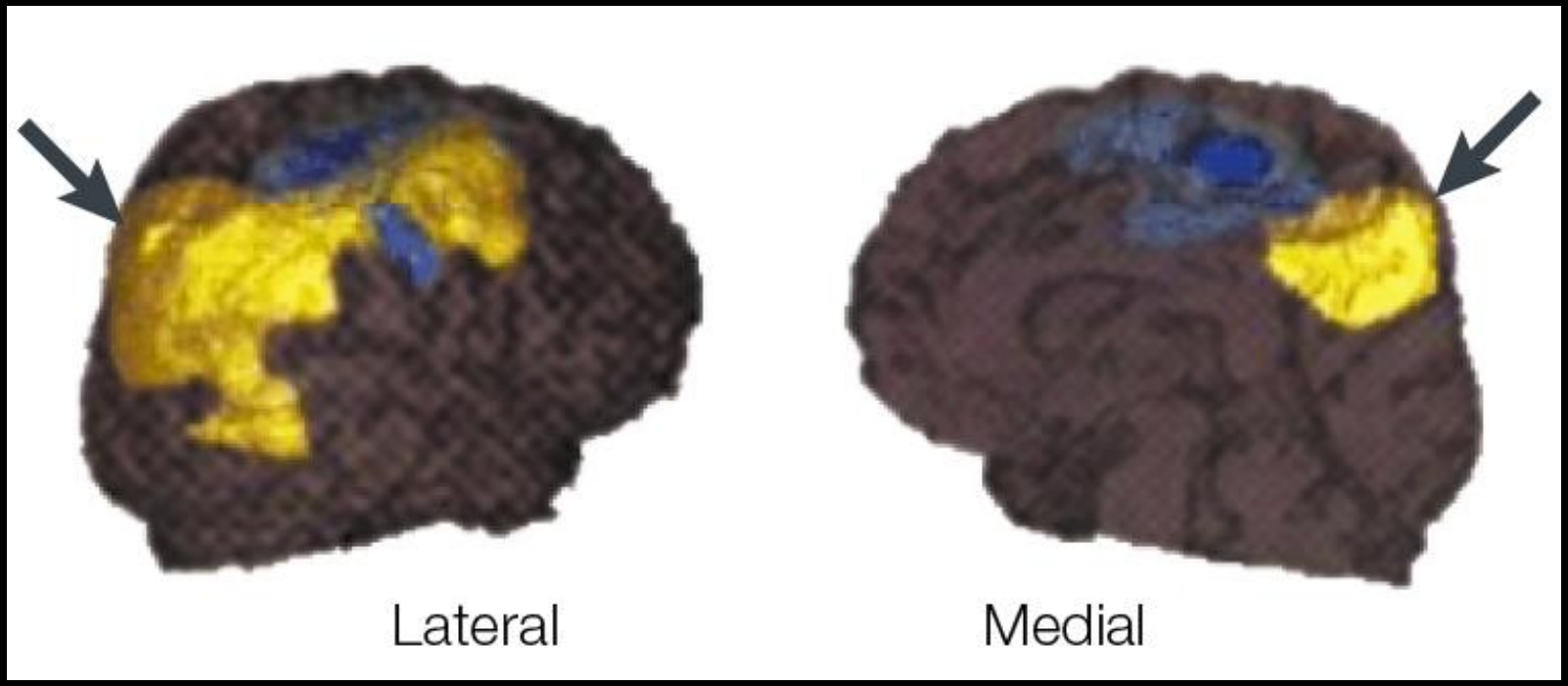


Merker (2007). Trends in Cognitive 9:556

Anencefalia. Estado vegetativo

Figure 9. The reaction of a three-year-old girl with hydranencephaly in a social situation in which her baby brother has been placed in her arms by her parents, who face her attentively and help support the baby while photographing.

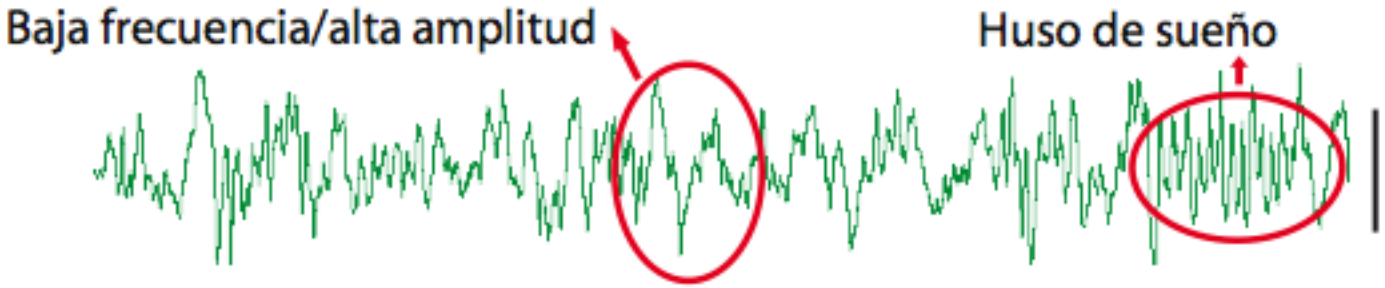
Merker (2007). Trends in Cognitive 9:556



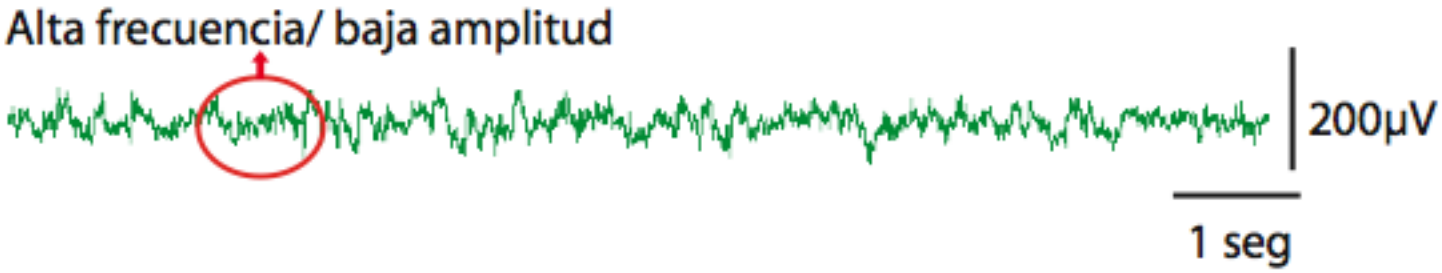
Laureys et al. (1999). J Neurol Neurosugr Psychat 67:121

Vigilia

Sueño NREM



Sueño REM



Estados comportamentales y funciones cognitivas

Vigilia
-alerta
-“day-dreaming”

NREM
-N1, “sleep onset” o hipnagogia.
-N2
-N3

REM

Ensueños

Foulkes: cualquier experiencia mental durante el sueño.

Otros autores: experiencias perceptualmente vividas y coherentes desde el punto de vista narrativo.

Estados disociados y funciones cognitivas

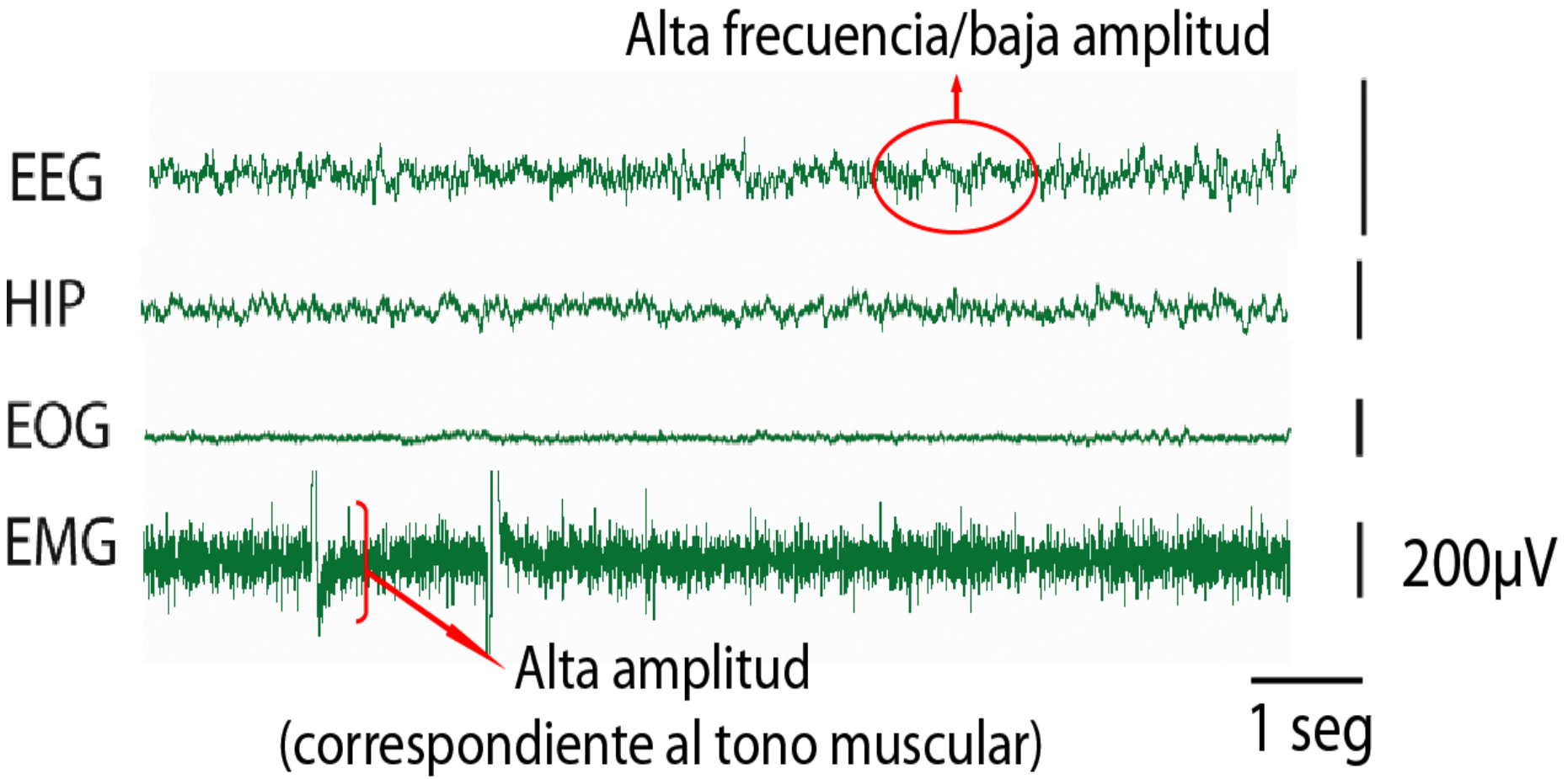
“**Despertar motor, con funciones cognitivas de sueño**”

- Sonambulismo (sueño NREM)
- Desorden del sueño REM

“**Estado disociado cognitivo**”

- Inercia del sueño (aspectos de sueño NREM en vigilia)
- Alucinaciones hipnagógicas (aspectos de sueño REM en vigilia)
- Sueños lucidos (aspectos de vigilia en sueño REM)

Vigilia

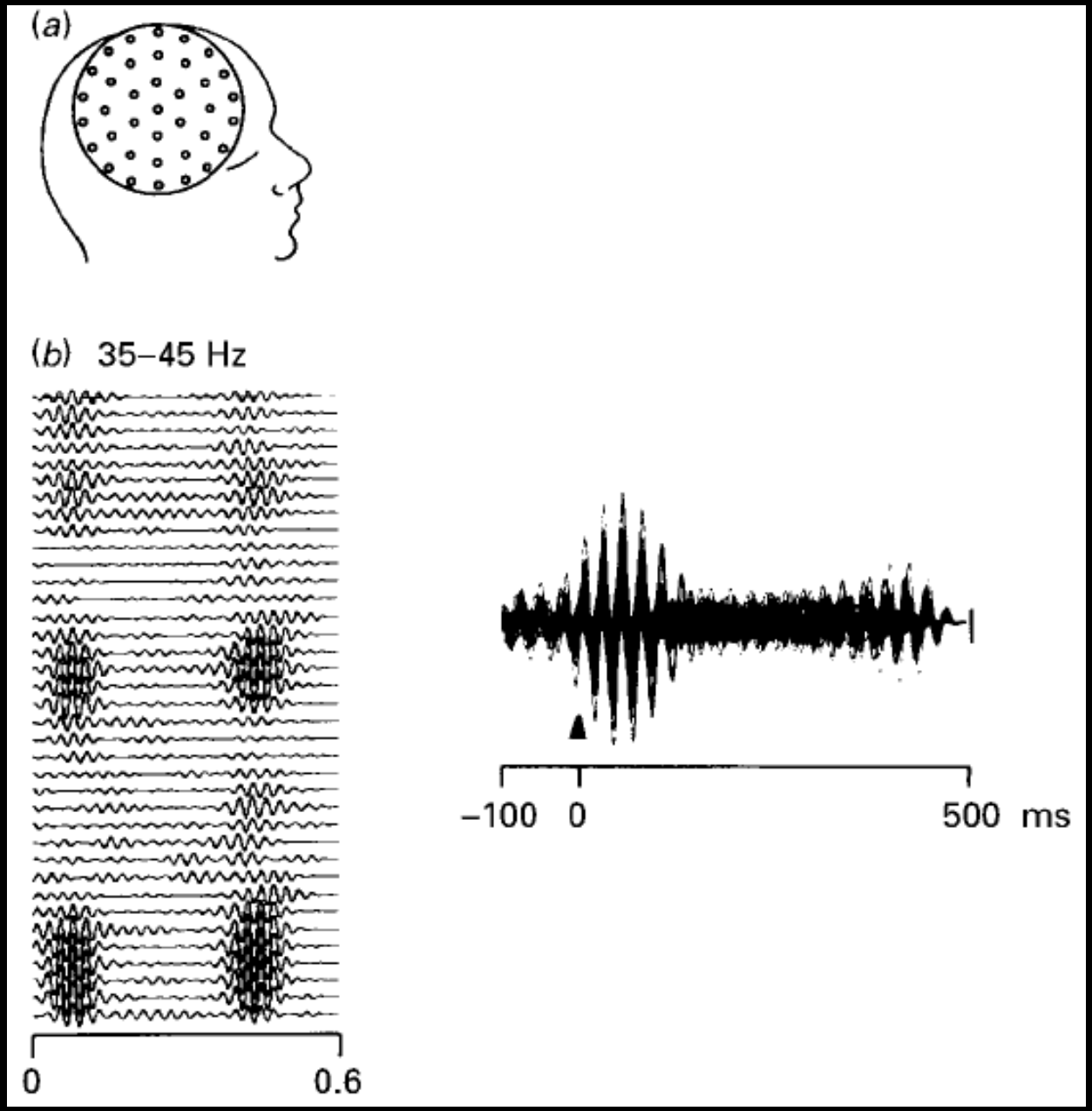

Alta frecuencia/baja amplitud
EEG
HIP
EOG
EMG
200µV
Alta amplitud
(correspondiente al tono muscular)
1 seg

Vigilia

- Actividad sensorial.
- Todos los sistemas activadores estan encendidos.

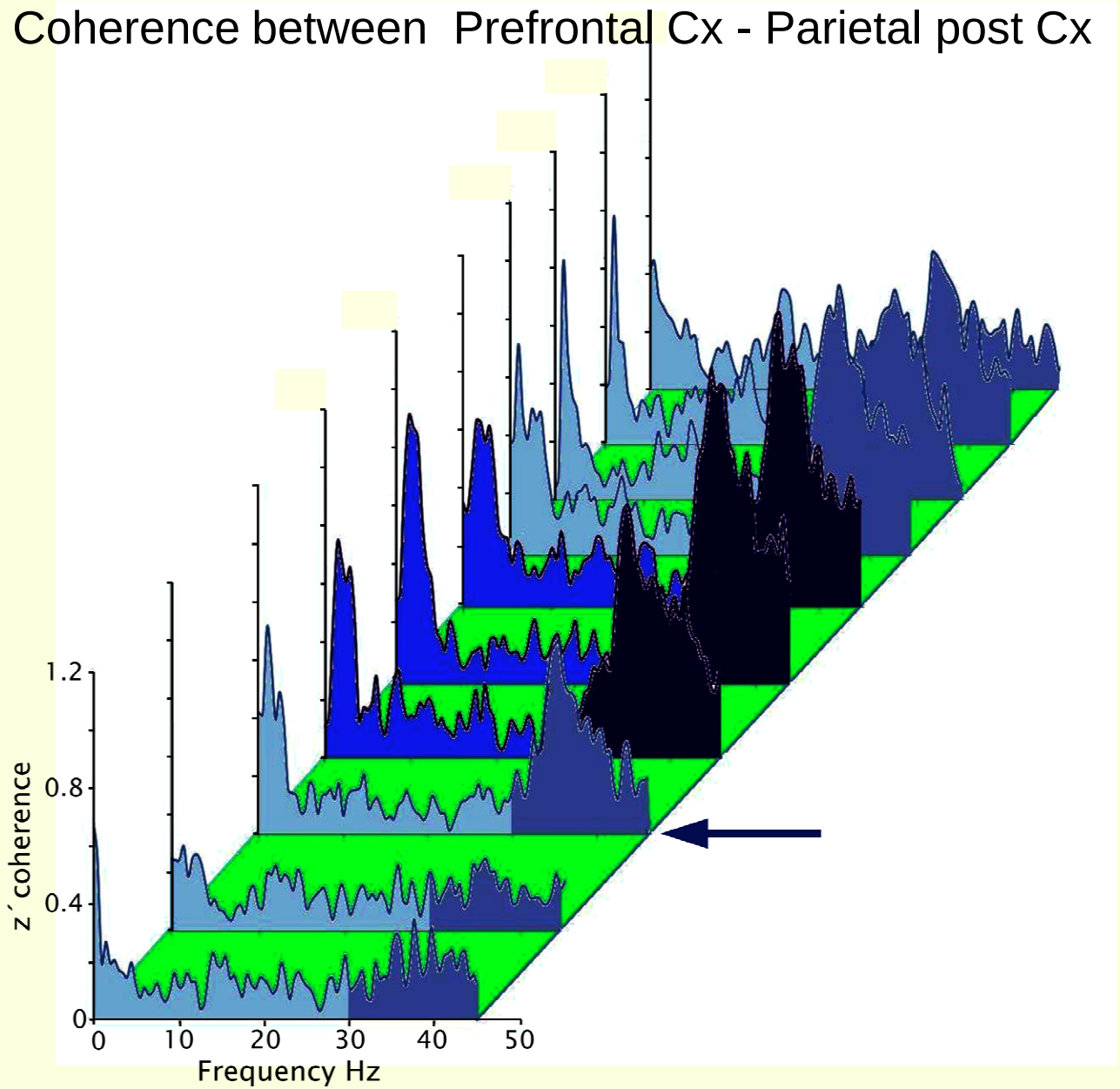
EEG
- Ausencia de ondas lentas.
- Actividad y coherencia gamma (≈40 Hz).

Coherencia de la banda gamma (40 Hz) de frecuencias durante la vigilia



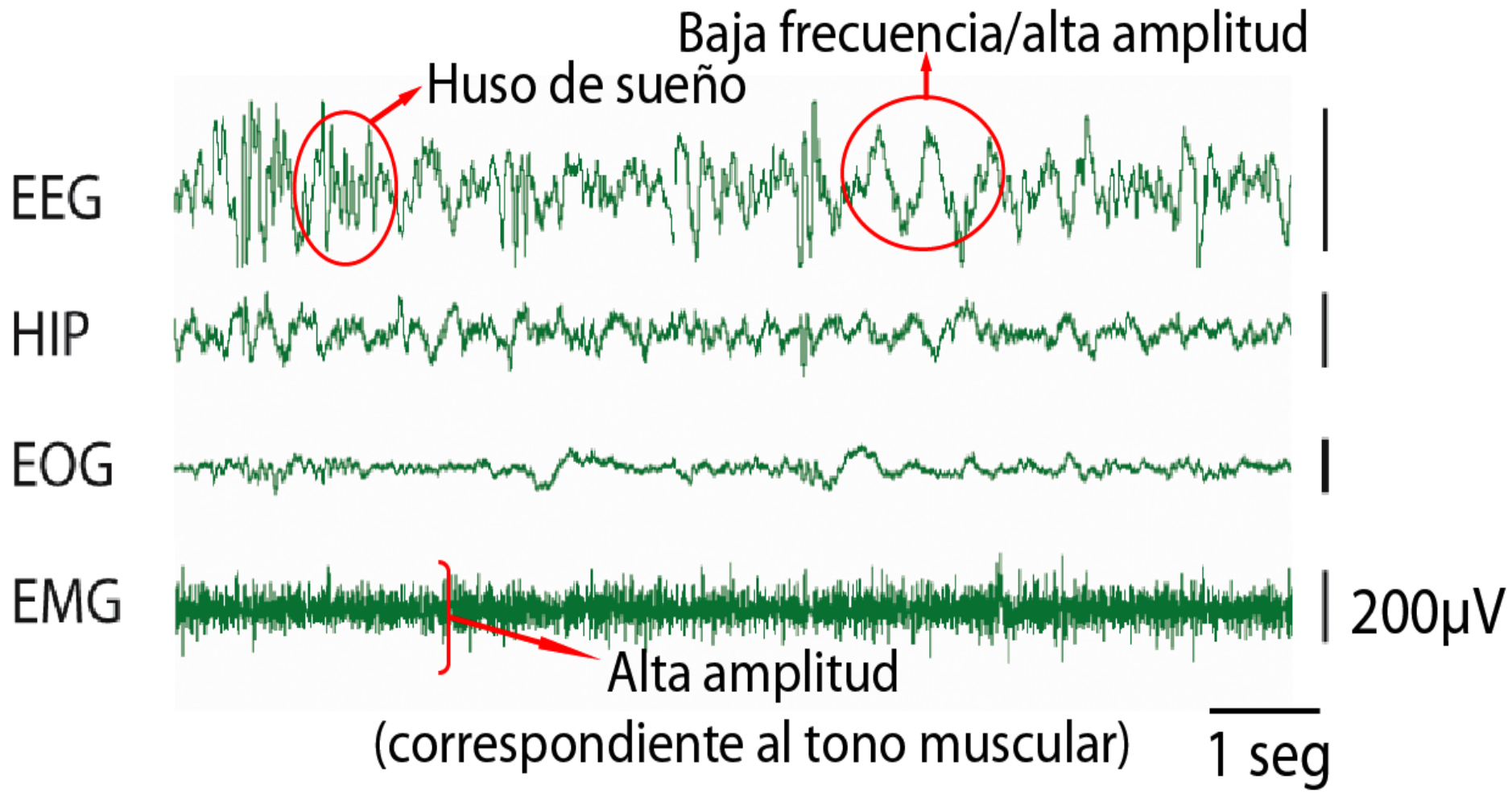
Llinas et al. (1998). Phil Trans R Soc Lond 353:1841

Coherence between Prefrontal Cx - Parietal post Cx



Castro et al. (2013). Eur J Neuroscience, 37:1330

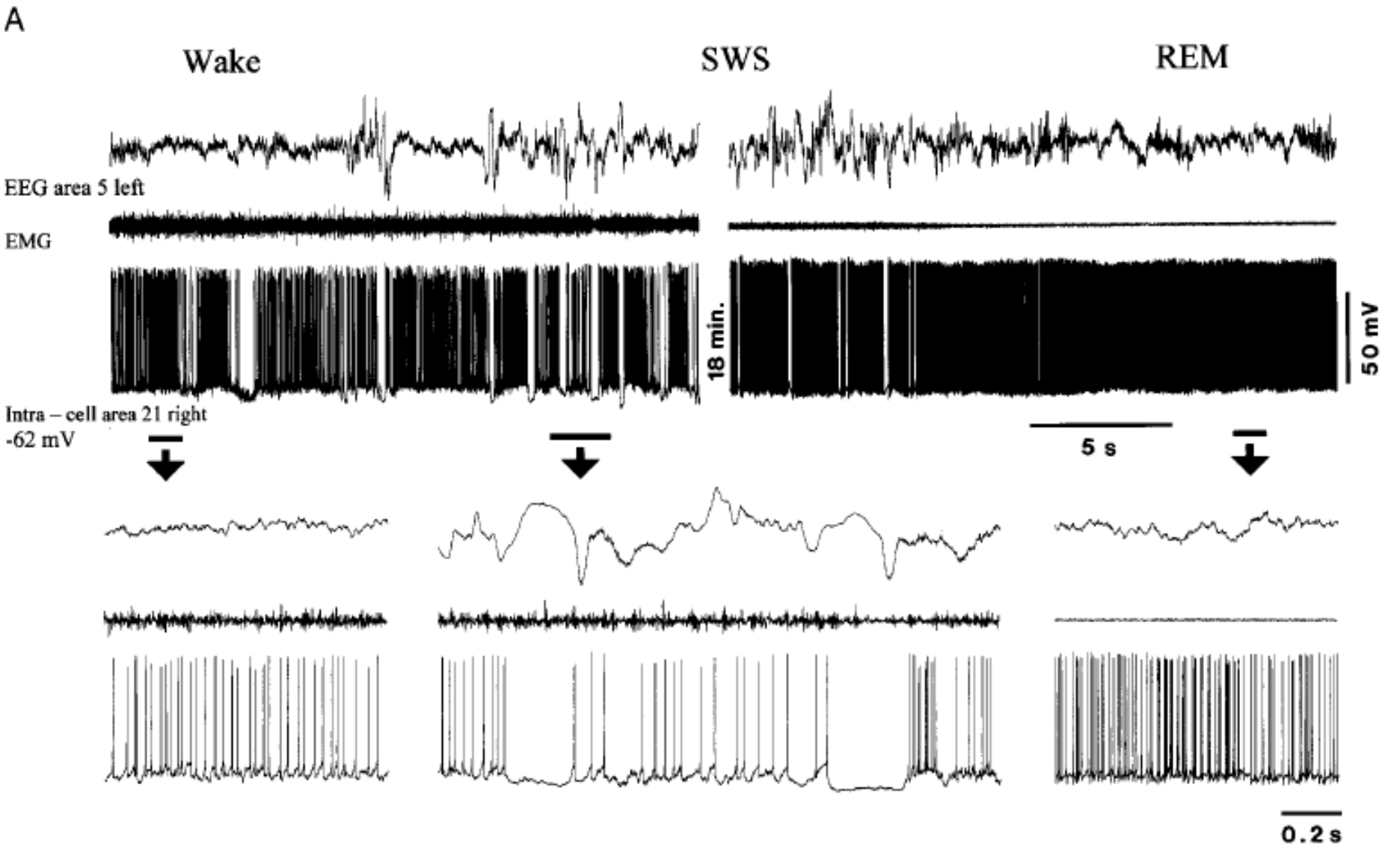
Sueño NREM


Baja frecuencia/alta amplitud
Huso de sueño
EEG
HIP
EOG
EMG
200µV
Alta amplitud
(correspondiente al tono muscular)
1 seg

Sueño NREM

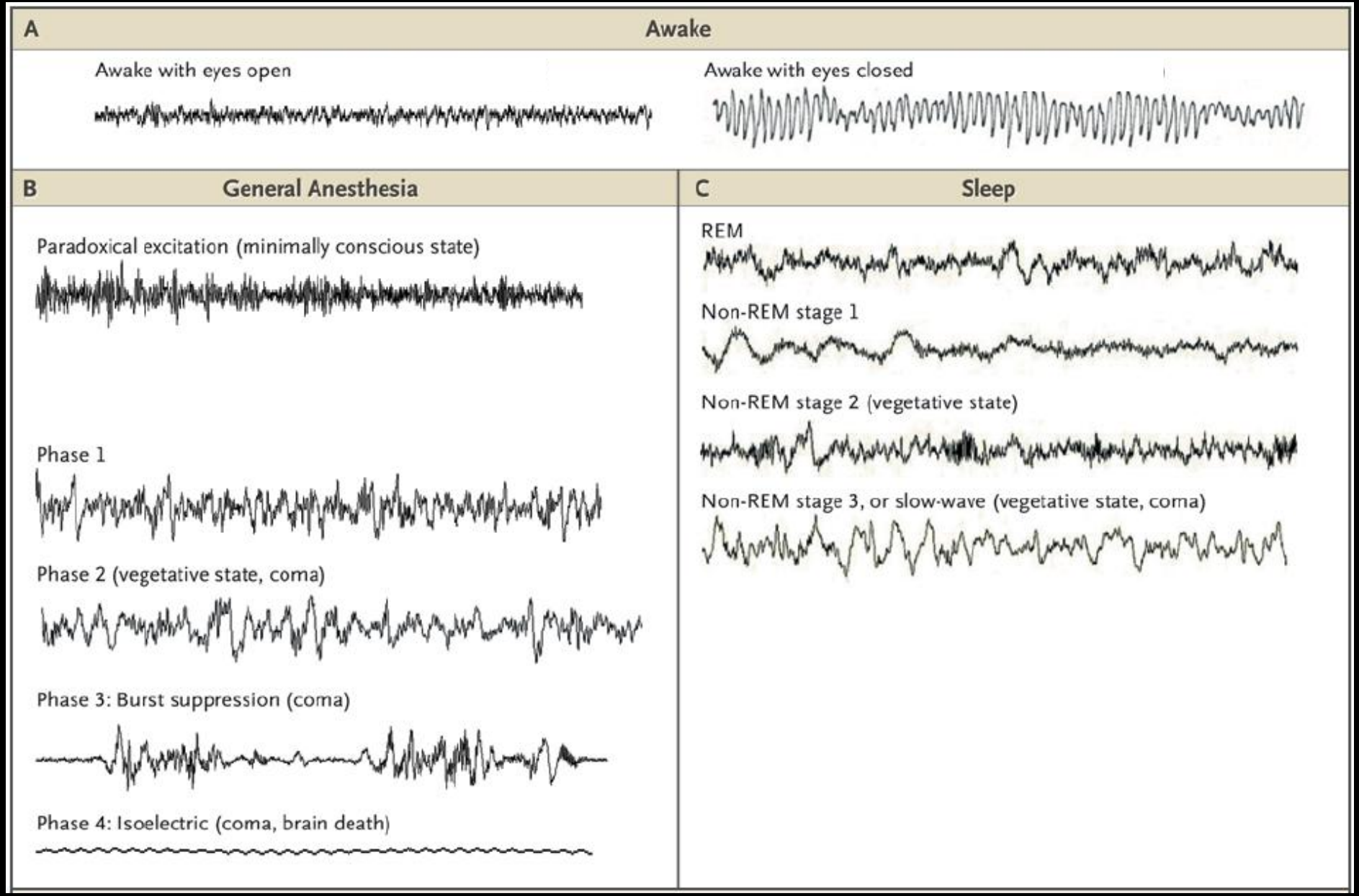
- NO actividad sensorial.
- Los sistemas activadores estan apagados.

EEG
- Ondas lentas, husos de sueño
- Baja actividad y coherencia gamma



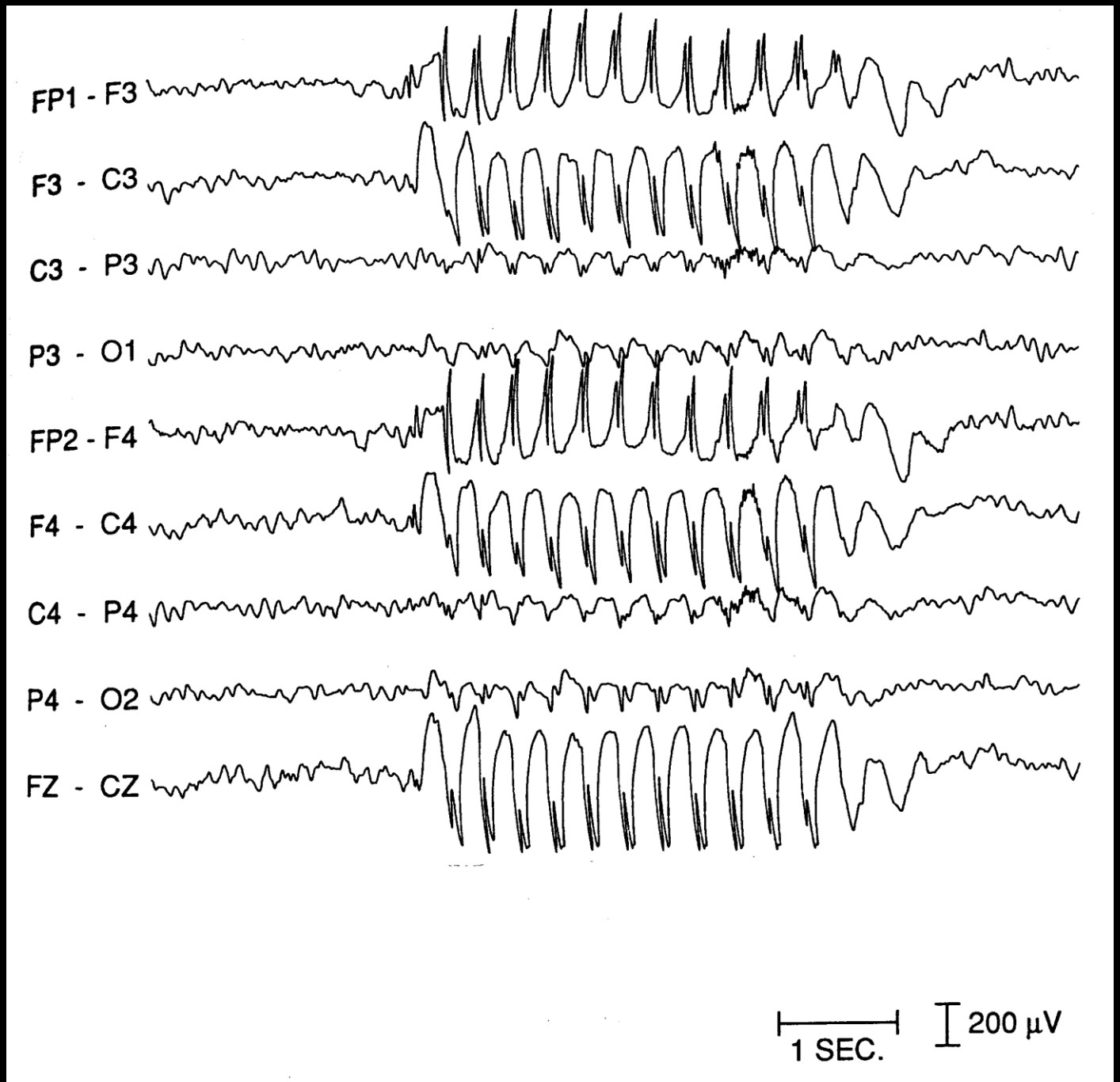
Steriade et al. (2001). J Neurophysiol., 85:1969

Similitudes entre el sueño lento profundo y la anestesia

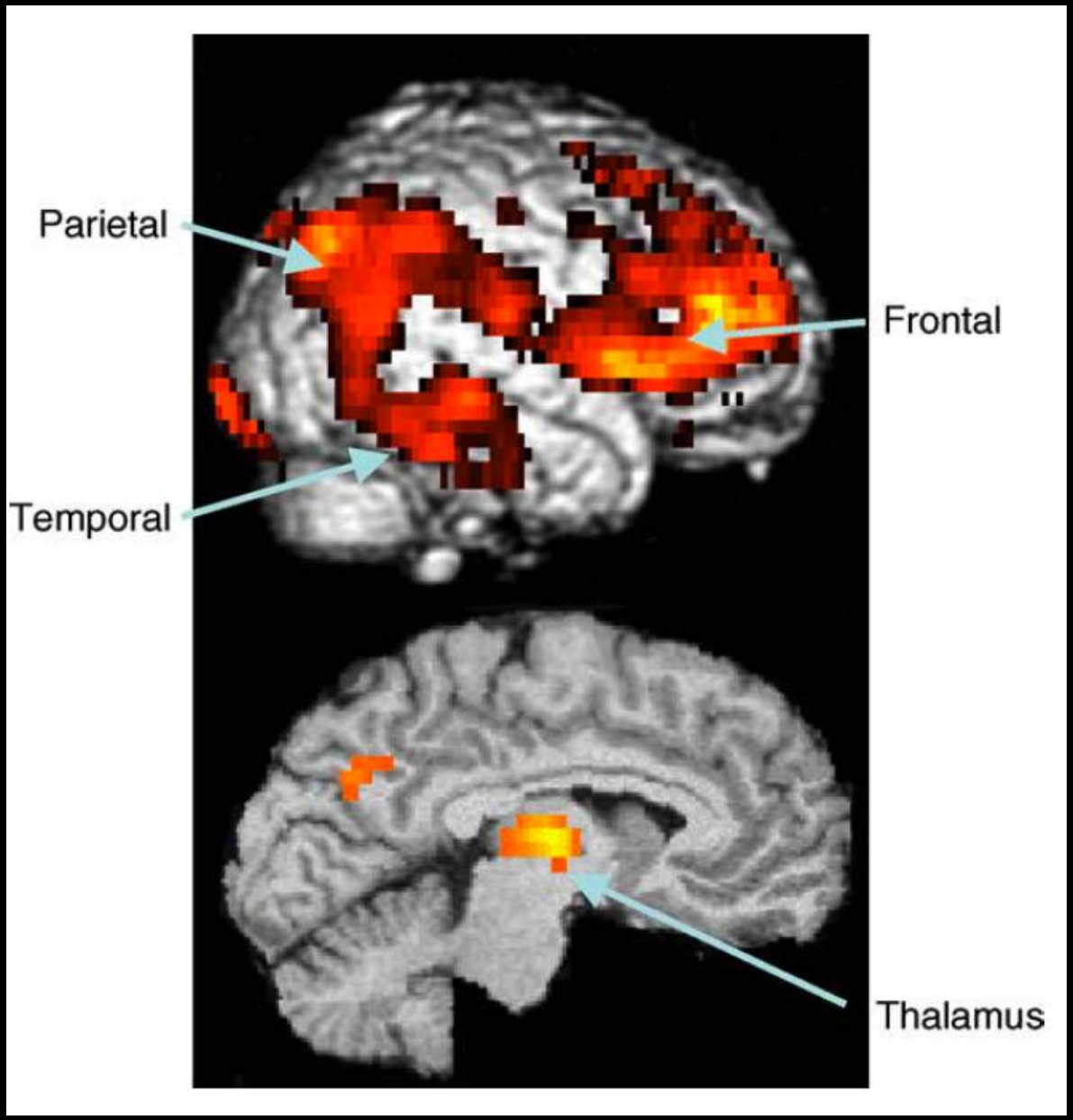


Brown et al. (2010). New Engl J of Med., 363:2638

La sincronización durante las crisis de ausencia determina la inconciencia

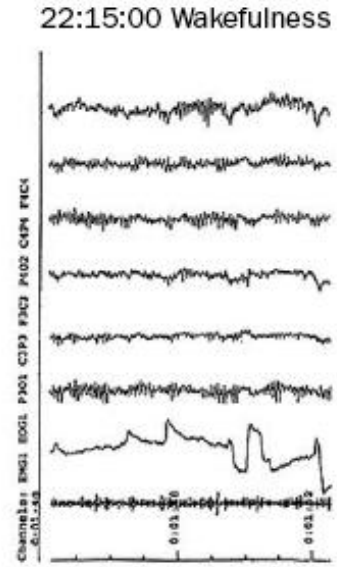


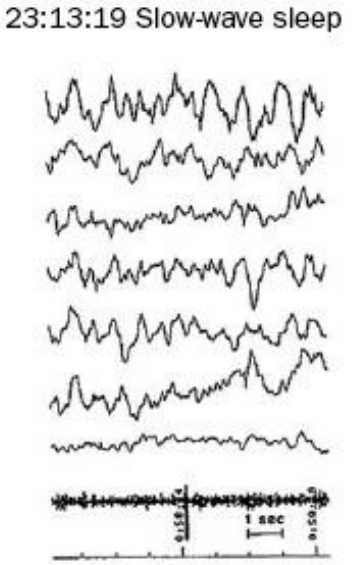
Las cortezas de asociación y el tálamo son las que mas se inhiben durante el sueño lento

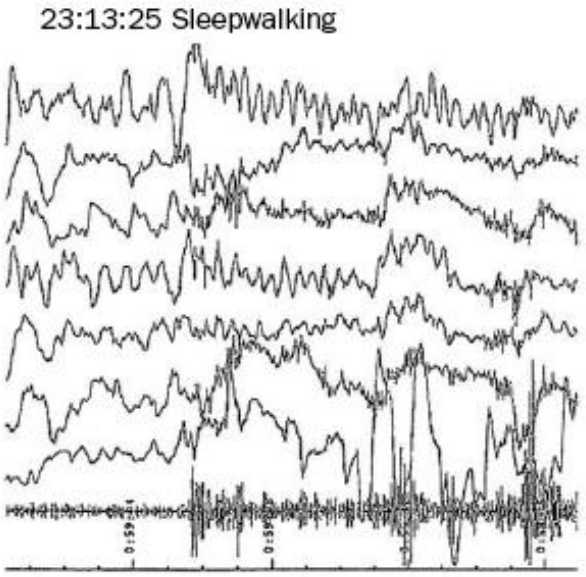


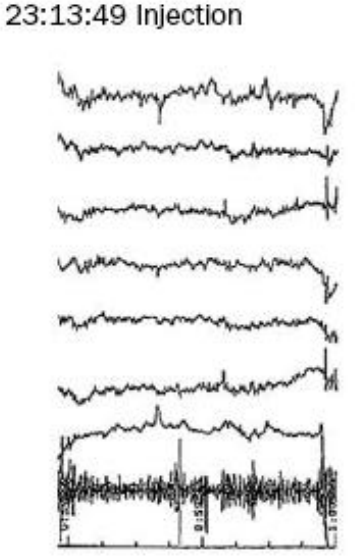
Nofzinger (2005). Sleep Med Rev 9:157

El sonambulismo ocurre durante el sueño lento



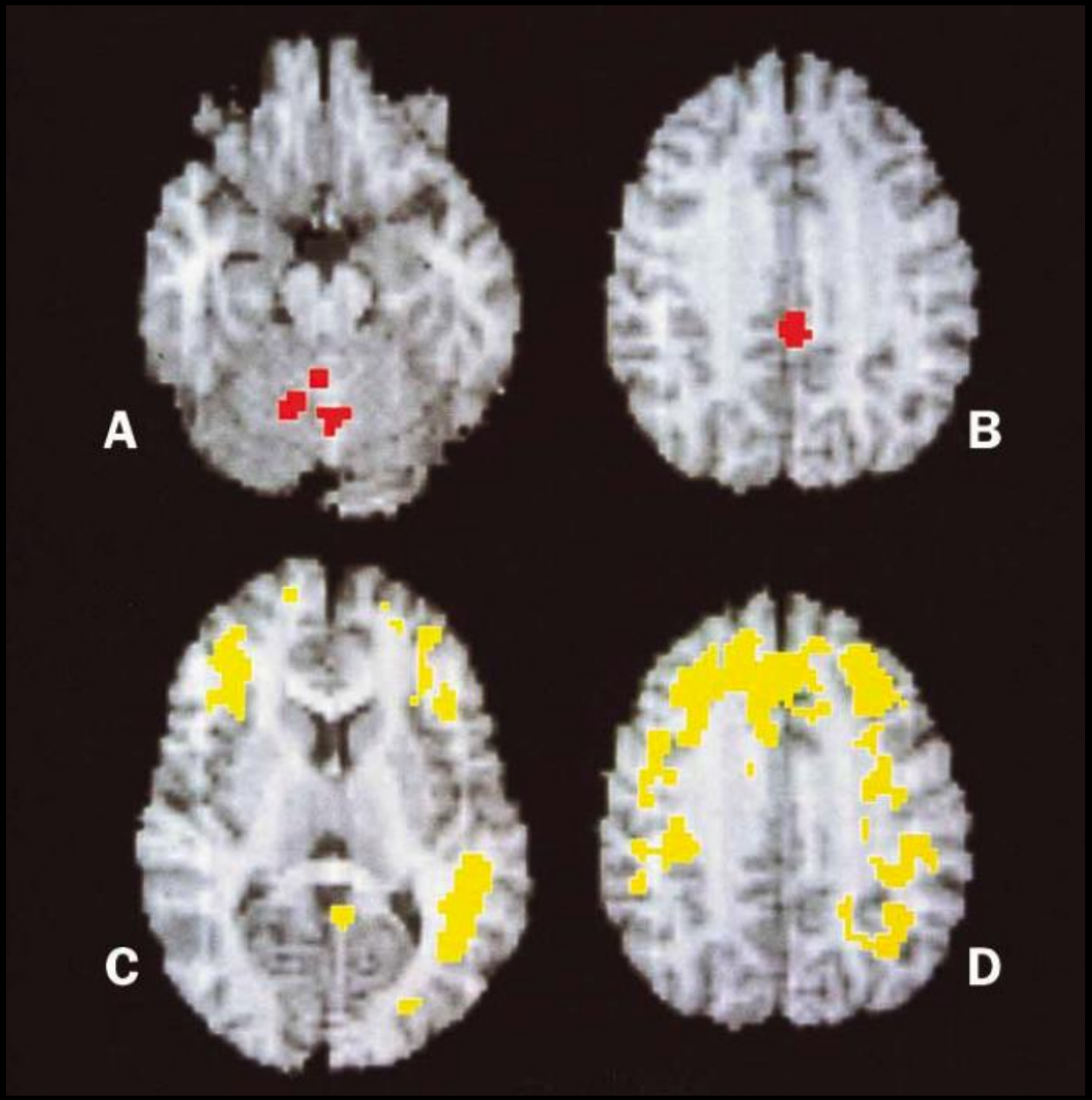






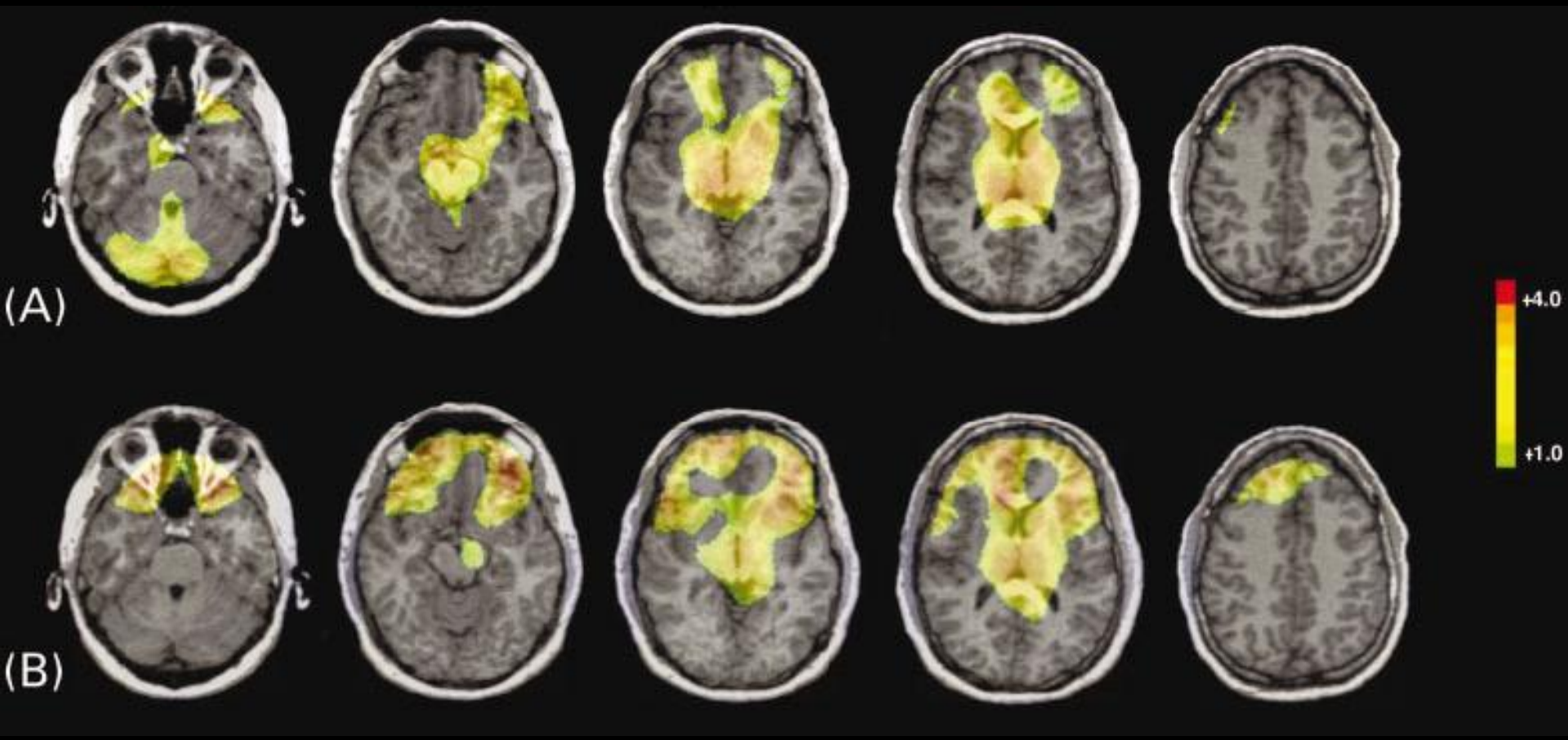
Bassetti et al. (2000). The Lancet 356:484

Actividad encefálica durante el sonambulismo

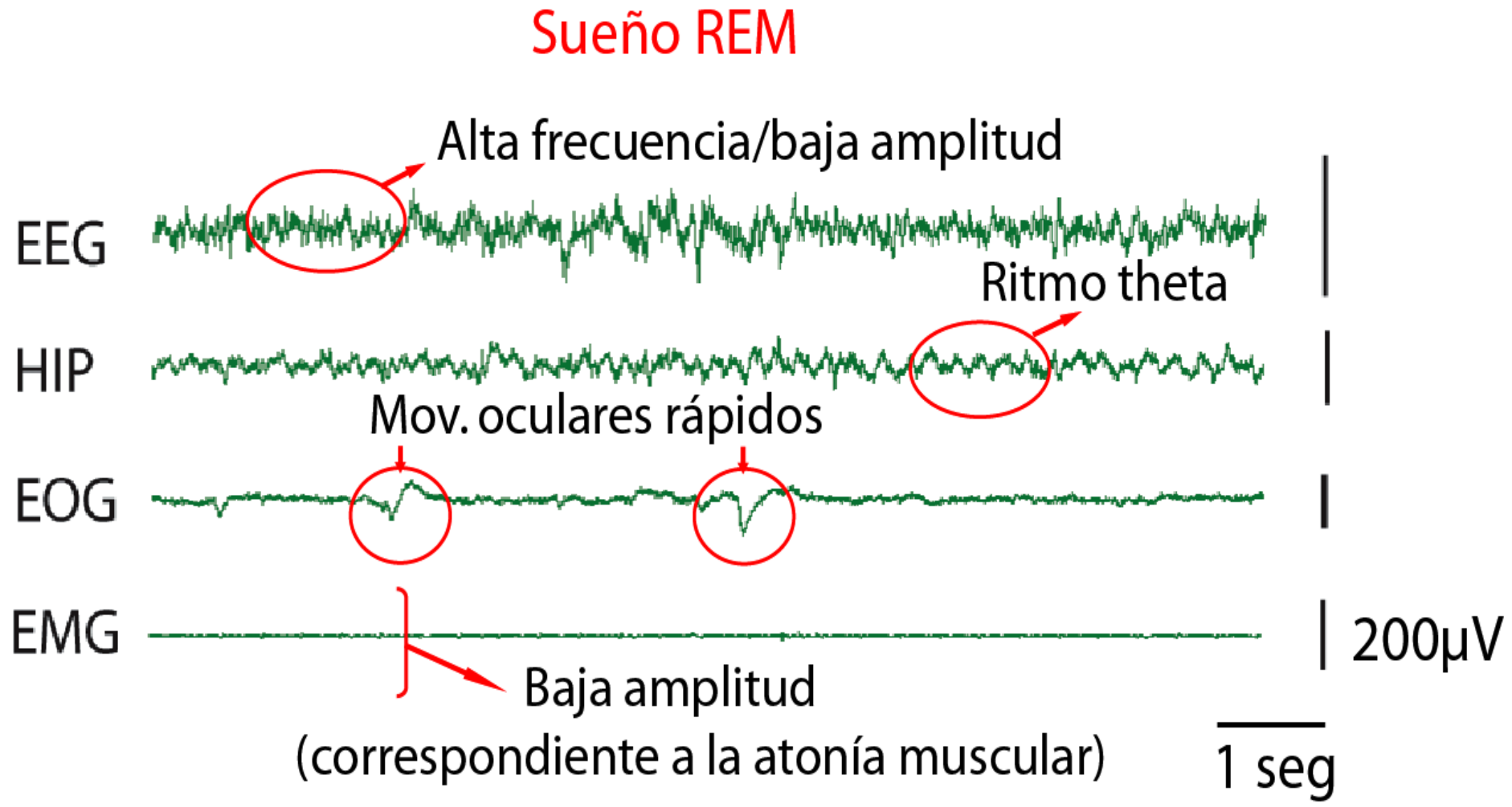


Bassetti et al. (2000). The Lancet 356:484

Actividad encefálica durante la inercia o “borrachera” de sueño



Balkin et al. (2002). Brain 125:2308

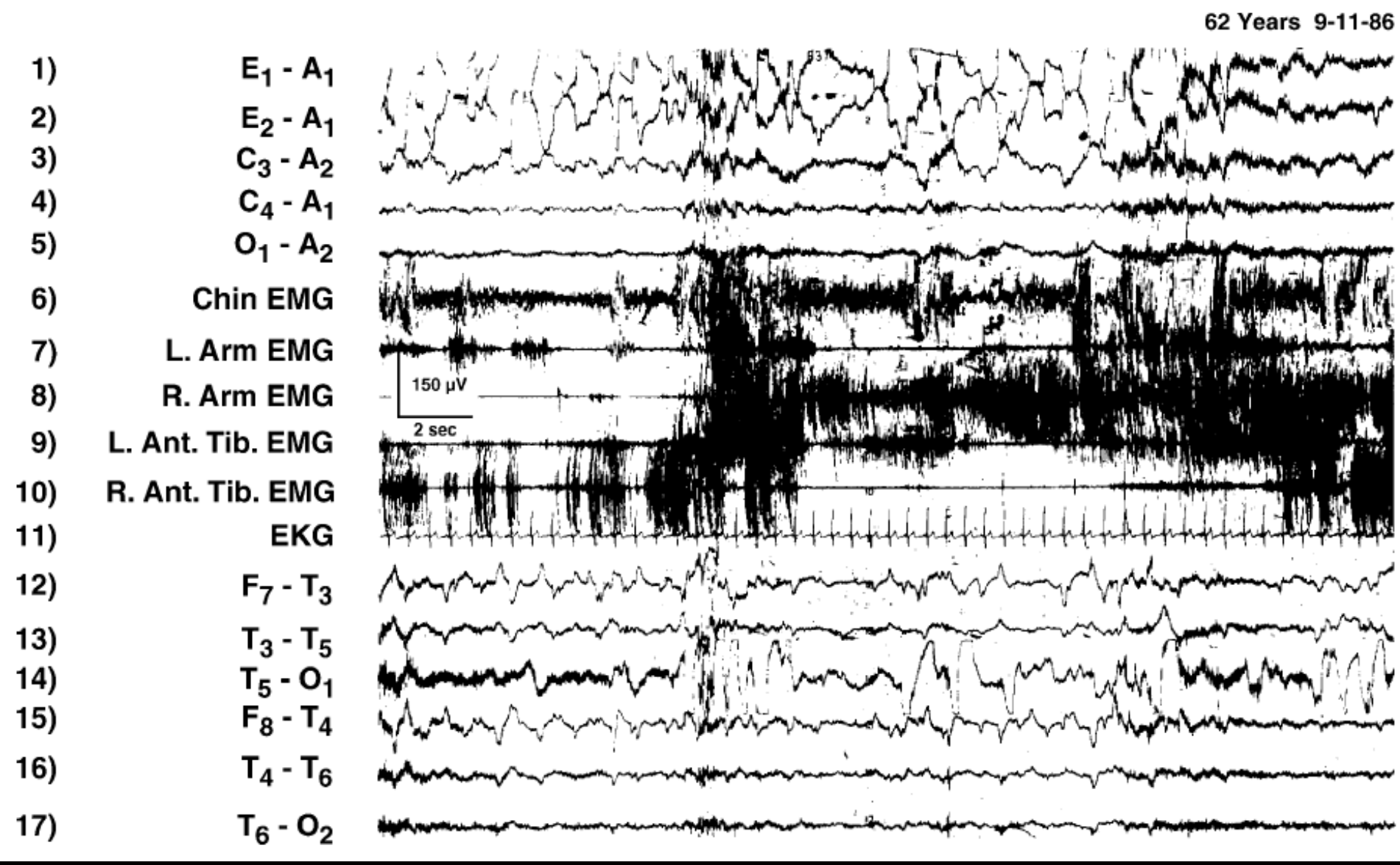

Sueño REM
Alta frecuencia/baja amplitud
EEG
Ritmo theta
HIP
Mov. oculares rápidos
EOG
EMG
200µV
Baja amplitud
(correspondiente a la atonía muscular)
1 seg

Sueño REM

- NO actividad sensorial.
- Enciende sistema colinérgico, se apaga el monoaminérgico.
- Ondas PGO.

EEG
- Ausencia de ondas lentas.
- Actividad gamma.
- NO coherencia gamma.

Desorden del sueño REM



Schenk y Mahowald (2003). Neurol. Clin., 23:1107

Correlacion entre la intensidad del REM y la del ensueño.

Correlacion entre la duracion del REM y la del ensueño.

Correlacion entre los movimientos de los ojos (scanning hypothesis) o del cuerpo del REM (en RBD) y lo vivido en los ensueños.

Carácterísticas de los ensueños

- Percepciones (alucinaciones) visuales y auditivos (intensos pero sin percepcion de detalles).
- Percepciones vívidas (vividas como reales).
- Bizarros: desorientados en tiempo y espacio, irracionales, discontinuos.
- Alto contenido emocional, con predominio de emociones negativas.
- Importante actividad física.

- Totalmente enfocados en la historia (“single-mindeness and isolation of dreams”).
- Raramente episódicos.
- Recogen elementos de lo vivido durante el día (residuos del día).
- Asociaciones de memorias lejanas.

Conciencia primaria o protoconciencia

- No reflexivo. Lo vivido (por mas bizarro que sea) se acepta como real.
- No volición.
- Poco pensamiento abstracto.
- No metacognicion. No se reconoce que se esta soñando (no autoreflexivos).

- No se recuerdan (no consolidación).

Sleep inspires insight

Ullrich Wagner[1], Steffen Gais[1], Hilde Haider[2], Rolf Verleger[3] & Jan Born[1]

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[2]*Institute of Psychology, University of Cologne, Gronewaldstrasse 2, 50931 Cologne, Germany*
[3]*Department of Neurology, University of Lübeck, Ratzeburger Allee 160, 23538 Lübeck, Germany*

Insight denotes a mental restructuring that leads to a sudden gain of explicit knowledge allowing qualitatively changed behaviour[1,2]. Anecdotal reports on scientific discovery suggest that pivotal insights can be gained through sleep[3]. Sleep consolidates recent memories[4–6] and, concomitantly, could allow insight by

without awareness. The time point when a subject gained insight into this rule could be determined precisely because at this time he/she would begin to cut short sequential responding to confirm the final solution in advance. All subjects were first trained on three task blocks to induce mental representations of the task that still remained implicit with regard to the hidden rule during this period. The training period was then followed by an 8-h interval of (1) nocturnal sleep, (2) nocturnal wakefulness, or (3) daytime wakefulness (Fig. 1b). Subsequently, subjects were retested on ten blocks.

Sleep more than doubled the probability of gaining insight into the hidden rule compared to wakefulness. In the sleep group, thirteen out of 22 subjects (59.1%) gained insight at retesting, compared to five subjects (22.7%) in either wake group ($\chi^2 = 8.54$, degrees of freedom (d.f.) = 2, $P = 0.014$; Fig. 2). For subjects gaining insight, the time point of its occurrence (number of blocks after beginning of retesting) did not differ significantly between groups (sleep, 4.5 ± 0.8 (mean ± s.e.m.); wake-night, 6.8 ± 1.5;

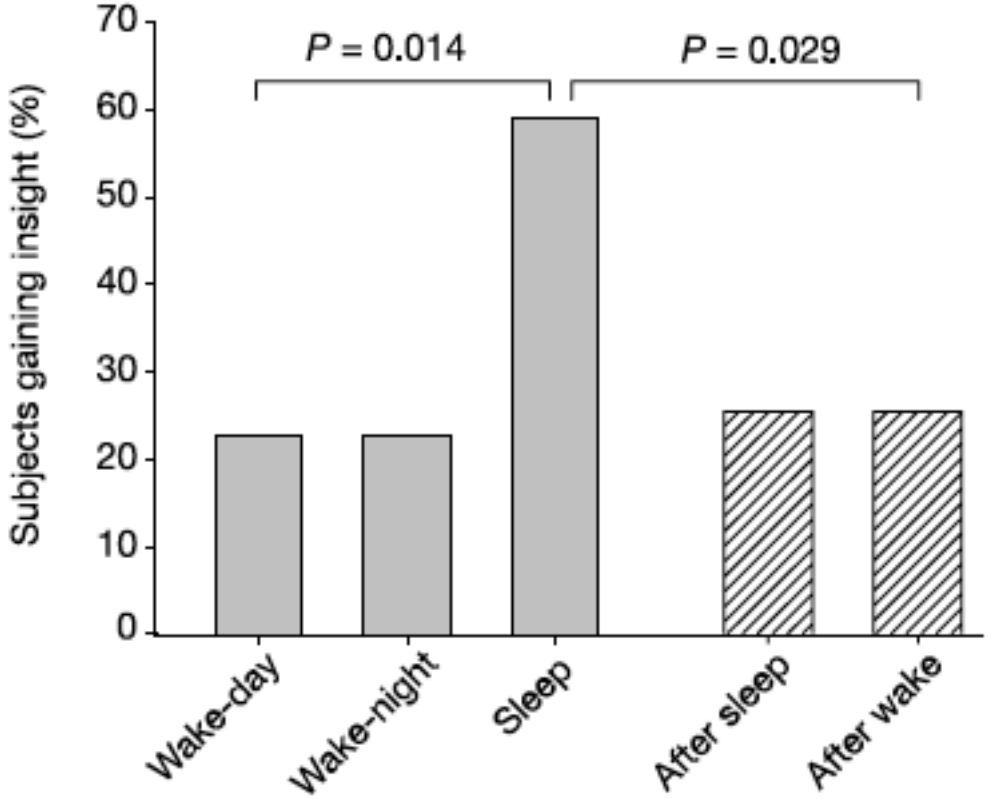
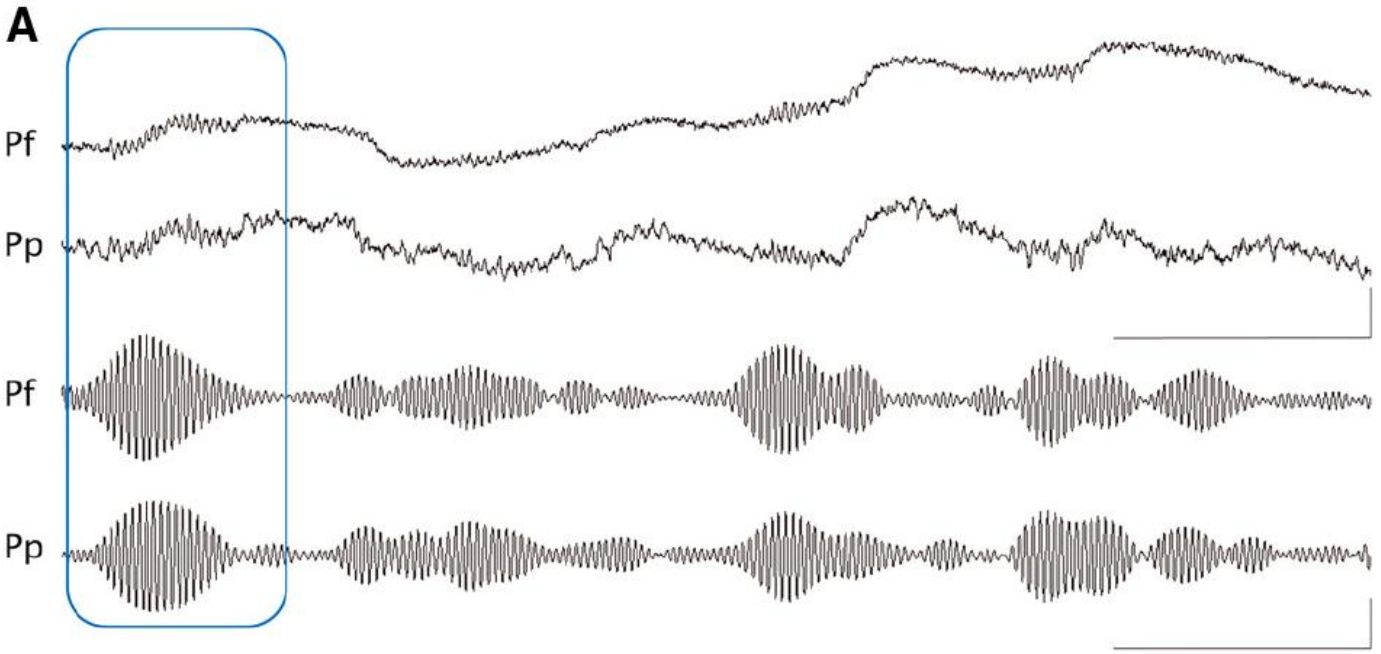
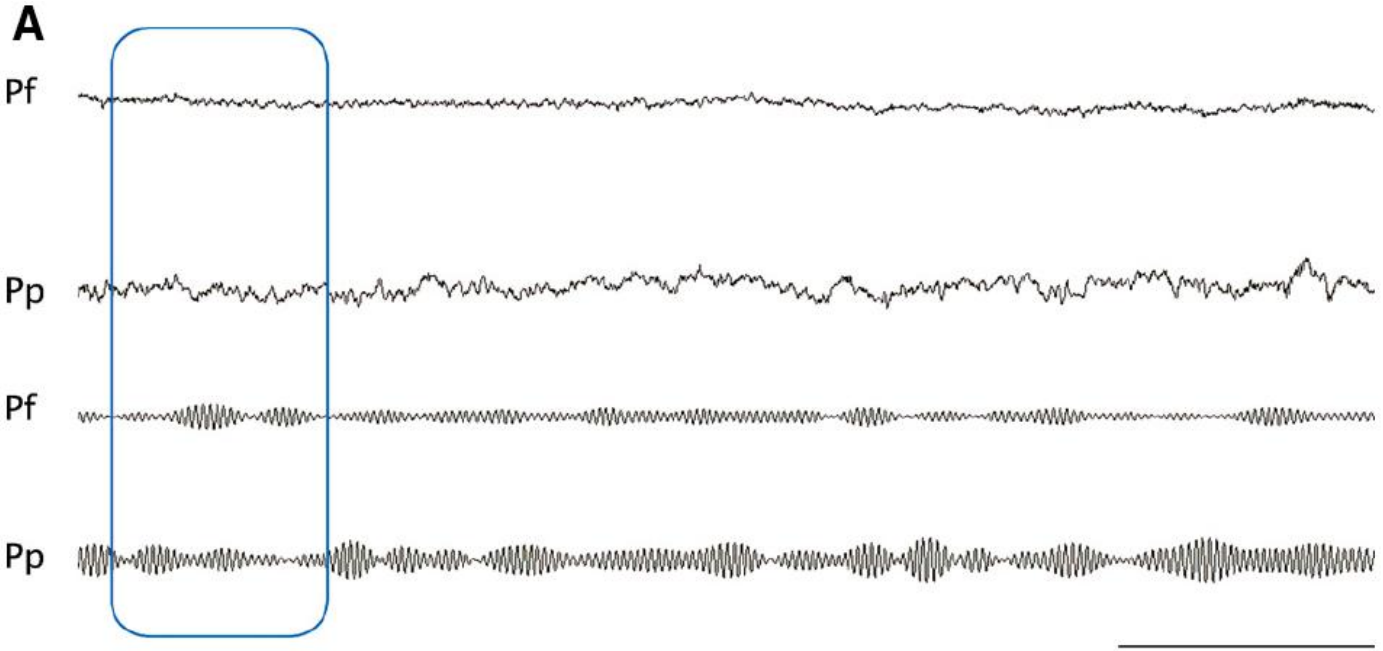


Figure 2 Effects of sleep and wakefulness on the occurrence of insight. Columns indicate percentage of subjects gaining insight into the hidden rule in the three experimental conditions of the main experiment (grey), in which subjects either slept (at night) or remained awake (at night or during daytime) between initial training and retesting, and in two supplementary conditions (hatched), where subjects were tested after nocturnal sleep or daytime wakefulness in the absence of initial training before these periods.

Alert wakefulness

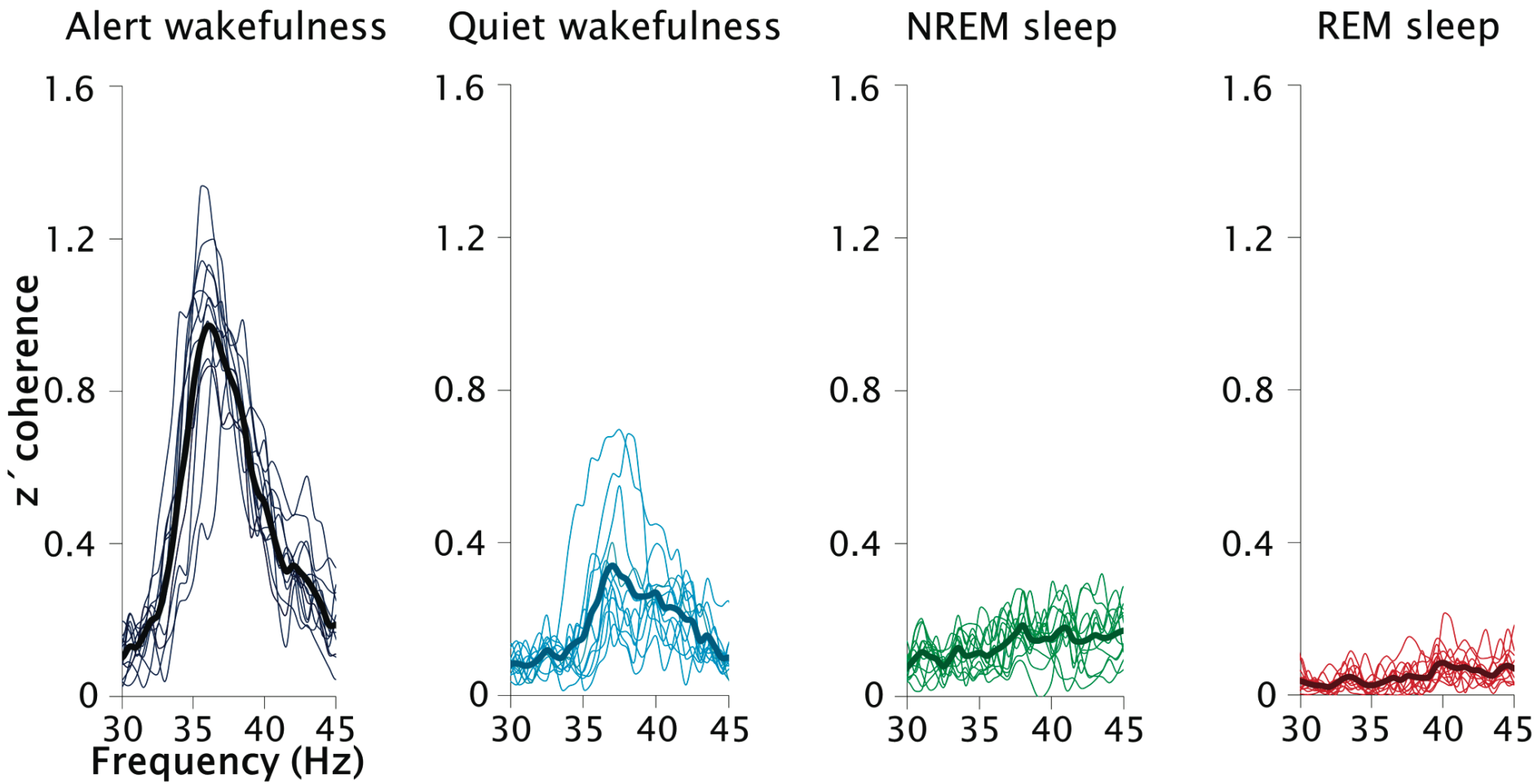


REM sleep



Castro et al. (2013). Eur J Neuroscience, 37:1330

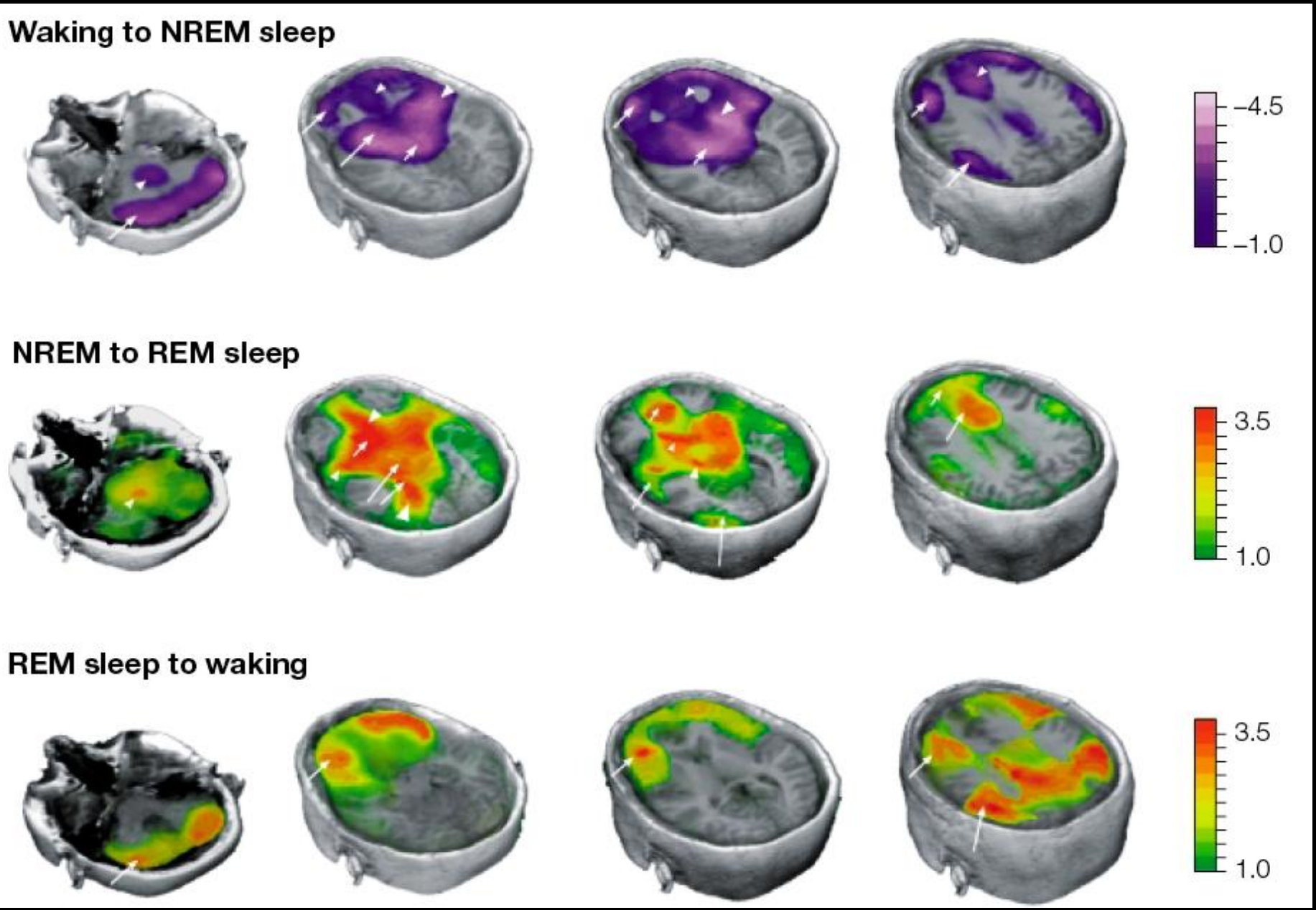
La coherencia gamma (40 Hz) es alta durante la vigilia y baja durante el sueño REM



Cx Prefrontal y Parietal posterior

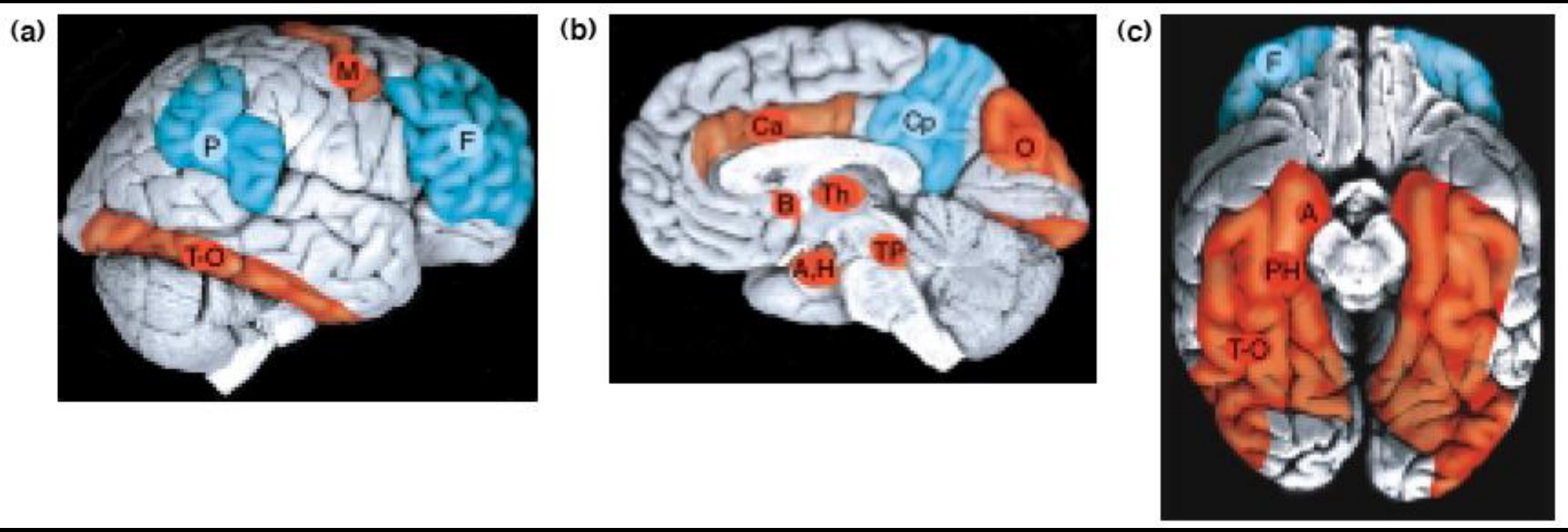
Castro et al. (2013). Eur J Neuroscience, 37:1330

Patrones de activación distintos en la vigilia y el sueño



Hobson y Pace Schott (2002). Nat. Rev., 3:679

Diferencias en la actividad encefálica entre sueño REM y vigilia



Swartz y Maquet (2002). Trends Cognitive Sciences 6:23

LUCID DREAMING

Lucid Dreaming: A State of Consciousness with Features of Both Waking and Non-Lucid Dreaming

Ursula Voss, PhD[1]; Romain Holzmann, Dr[2]; Inka Tuin, MD[3]; J. Allan Hobson, MD[4]

[1]JW Goethe-Universität Frankfurt and Rheinische Friedrich-Wilhems-Universität, Bon[2]Schwerionenforschung, GmbH, Darmstadt, Germany; [3]Johannes Gutenberg-Universitä[4]Center and Harvard Medical School, Boston, MA

Study Objectives: The goal of the study was to seek physiological correlates of lucid dreaming. Lucid dreaming is a dissociated state with aspects of waking and dreaming combined in a way so as to suggest a specific alteration in brain physiology for which we now present preliminary but intriguing evidence. We show that the unusual combination of hallucinatory dream activity and wake-like reflective awareness and agentive control experienced in lucid dreams is paralleled by significant changes in electrophysiology.

Design: 19-channel EEG was recorded on up to 5 nights for each participant. Lucid episodes occurred as a result of pre-sleep autosuggestion.

Setting: Sleep laboratory of the Neurological Clinic, Frankfurt University.

Participants: Six student volunteers who had been trained to become lucid and to signal lucidity through a pattern of horizontal eye movements.

Measurements and Results: Results show lucid dreaming to have REM-like power in frequency bands δ and θ, and higher-than-REM activity in the γ band, the 40 Hz b coherence l higher than lyzed. Rega coherence i In lucid drea

Conclusio state of con waking and

Keywords: EEG

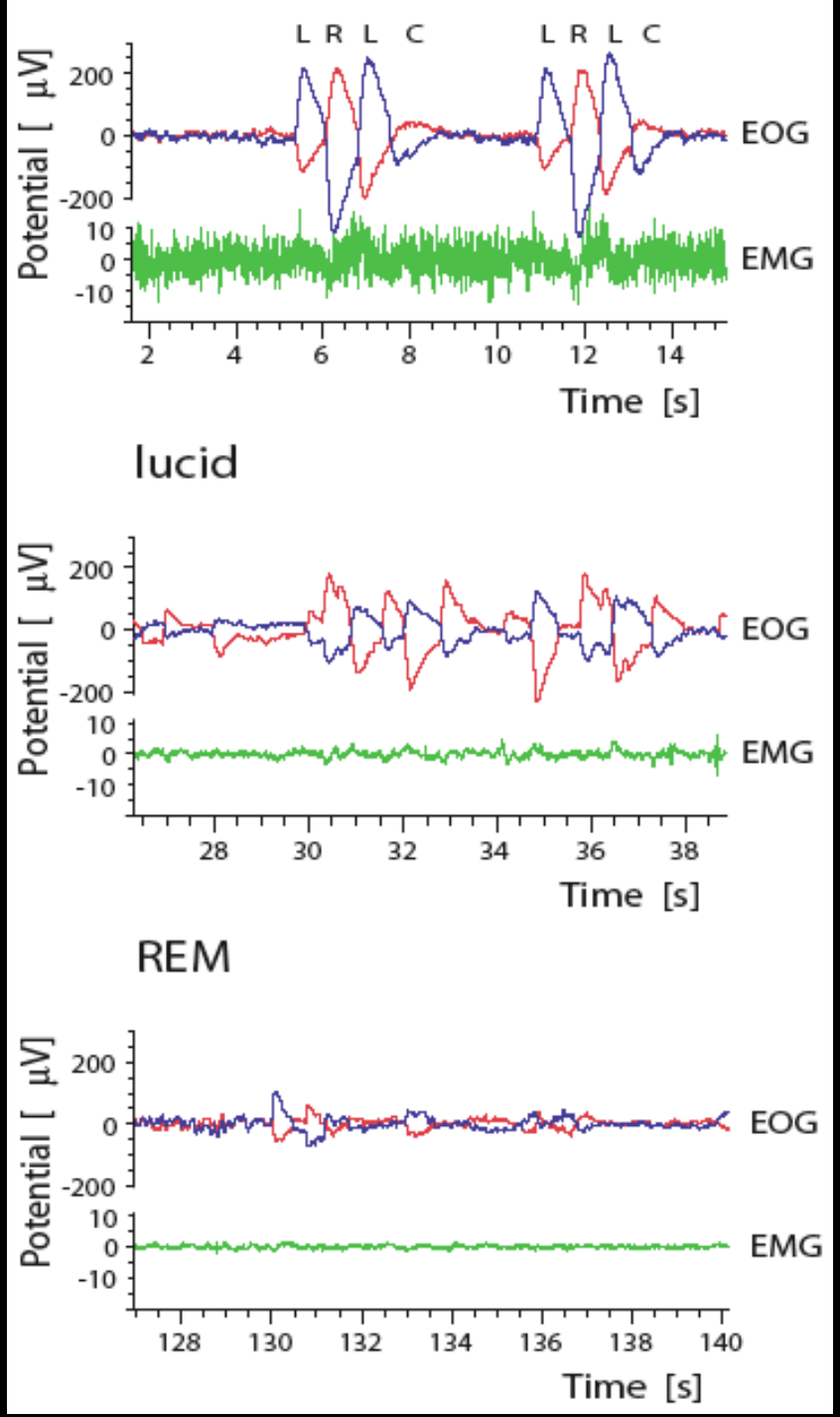
Citation: V a state of dreaming.

nature neuroscience

Induction of self awareness in dreams through frontal low current stimulation of gamma activity

Ursula Voss[1,2], Romain Holzmann[3], Allan Hobson[4], Walter Paulus[5], Judith Koppehele-Gossel[6], Ansgar Klimke[2,7] & Michael A Nitsche[5]

Recent findings link fronto-temporal gamma electroencephalographic (EEG) activity to conscious awareness in dreams, but a causal relationship has not yet been established. We found that current stimulation in the lower gamma band during REM sleep influences ongoing brain activity and induces self-reflective awareness in dreams. Other stimulation frequencies were not effective, suggesting that higher order consciousness is indeed related to synchronous oscillations around 25 and 40 Hz.



Voss et al. (2009). Sleep 32:1191

Carácterísticas de los ensueños, en relación a su posible función

-Emergen de la actividad neural que la produce. NO se puede separar o diferenciarla funcion del ensueño de la actividad neural del sueño REM.

-Teoria de la función de los ensueños debe abarcar la filogenia y ontogenia del sueño REM.

- ·El ensueño NO cumple una función durante el sueño REM, ya que el comportamiento esta inhibido.

- NO es necesario que sea recordado.

- REM/ensueño, cambio plástico de la actividad talamo-cortical que modifica la vigilia posterior (mejora emoción, recordamos mejor, soluciona problemas, nos entrena virtualmente para solucionar una futura dificultad).

Posibles funciones

- Desarrollo y mantenimiento neural.

-Consolidar, ordenar y adecuar memorias (“emotional down regulation” de Cartwright, “Reverse learning” de Crick, etc.).

- Practica virtual (“Threat simulation” de Revonsuo, solucionar problemas, etc)

Conclusiones

Sueño lento profundo.

No hay actividad conciente. La sincronización neuronal generalizada y la disminución de la actividad gamma no lo permiten.

- **Sueño REM.**

Hay actividad cognitiva (ensueños).

Inactivación de la corteza prefrontal dorsolateral y un aumento de la actividad límbica.

Disminuye la integración funcional entre distintos sectores corticales para la banda gamma de frecuencias.

“El sueño”. Henry Rousseau