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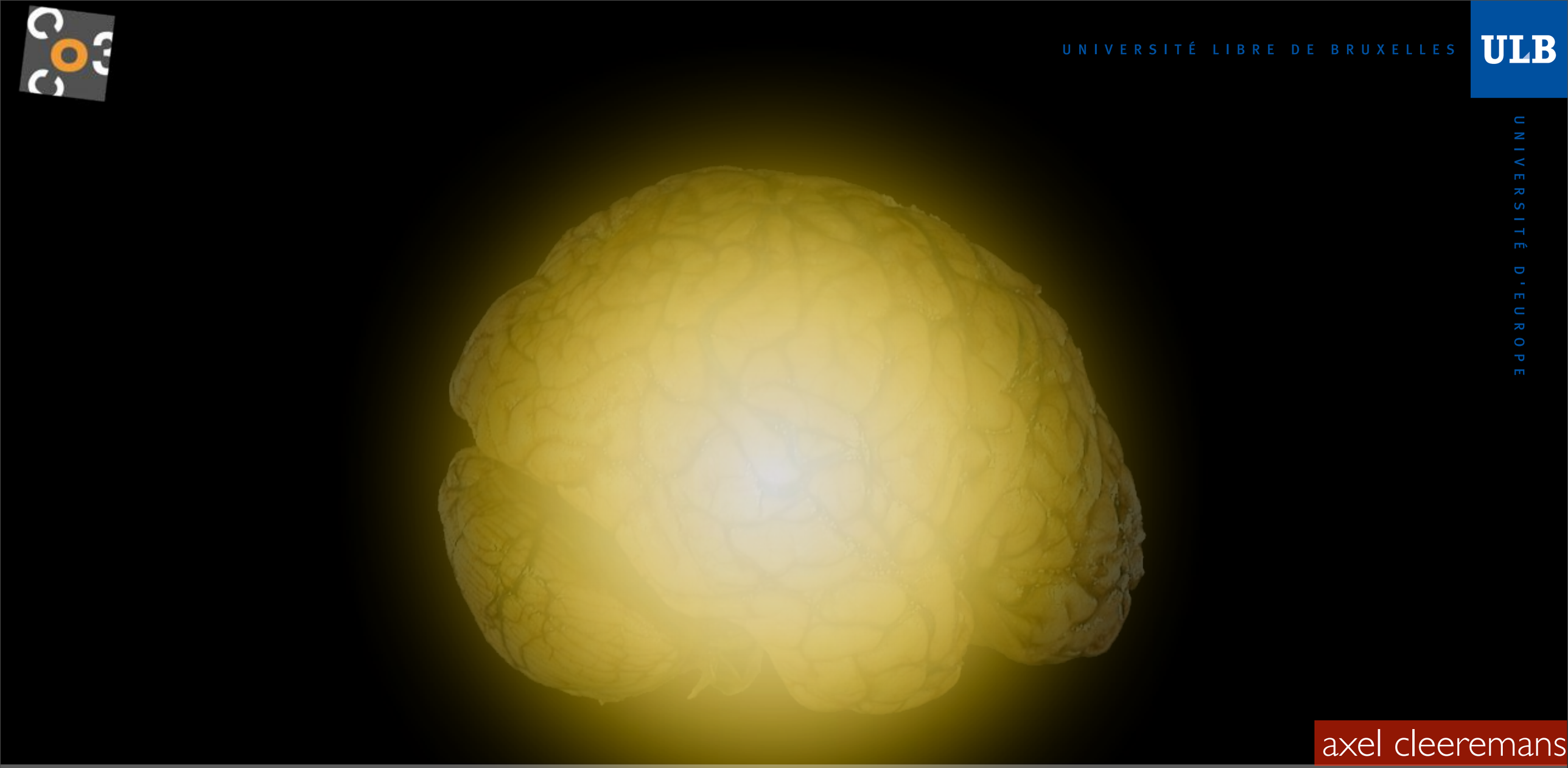
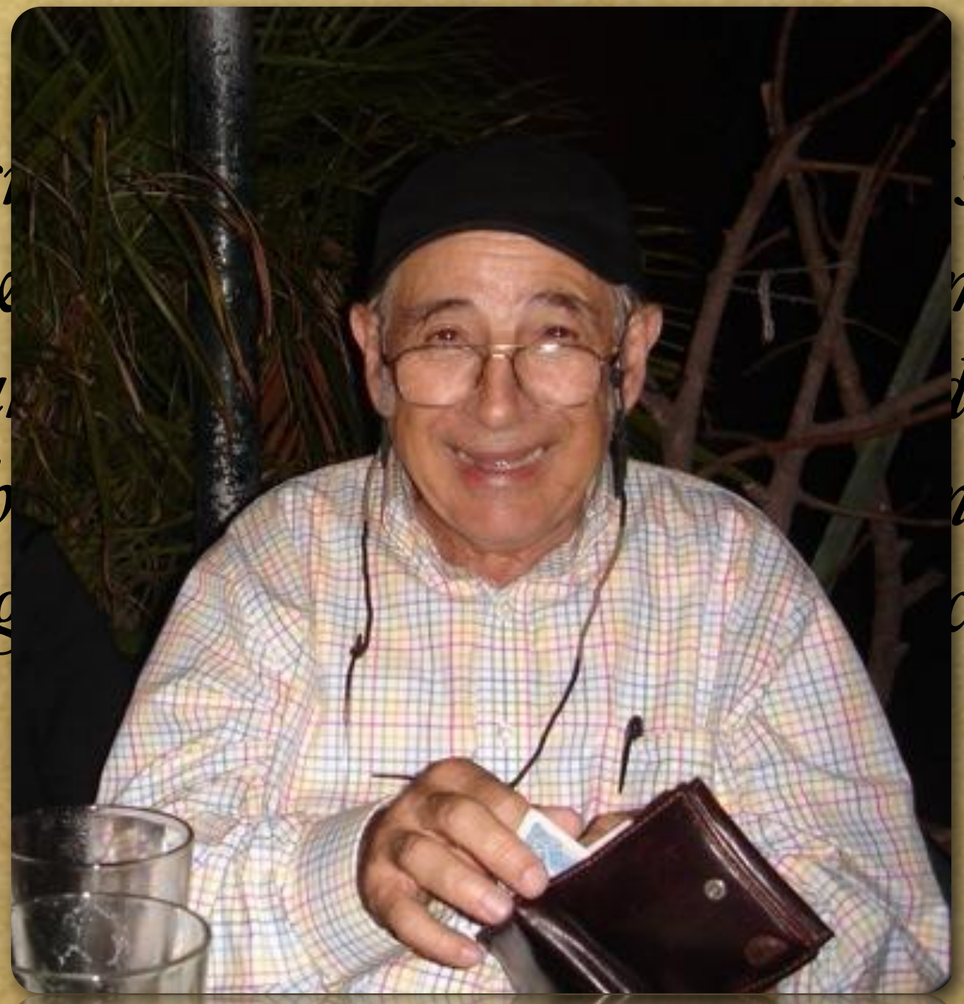


axel cleeremans

CONSCIENCE ET ETAT VEGETATIF

QU'EST-CE QUE LA CONSCIENCE?

"Consciousn *sensation, or*
feeling, or aw *morning when*
we awa *d continue*
throughout th *na, or die, or fall*
asleep ag *conscious".*



JOHN SEARLE

QU'EST-CE QUE LA CONSCIENCE?

Personne ne le sait!!

QUEL EFFET CELA FAIT-IL D'ETRE UNE CHAUVE-SOURIS?

Nagel (1974): Nous aurions beau tout savoir à propos du système nerveux des chauve-souris, nous n'en saurions toujours pas plus sur l'effet que cela fait de chasser des insectes au crépuscule en percevant l'espace avec ses oreilles...

QU'EST-CE QUE LA CONSCIENCE?

"Nothing is *distant as our*

Thomas Metzinger

LE PROBLEME DIFFICILE...

"Numerous books a *usness have appeared recently, and one mig* *t in reality, these works have ignored the ha* *hat one might call the 'easy problems' of co* *ocess information? How does it integrate in* *verbal reports on our mental states? These* *swering them does not solve the hard prob* *formation processing is accompanied by subj*

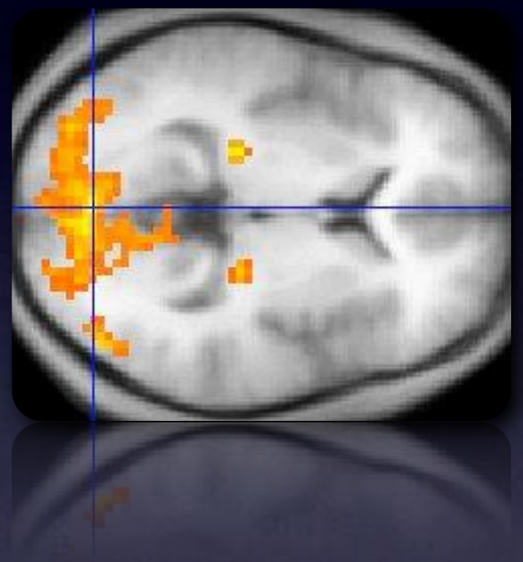
DAVID CHALMERS

LA CONSCIENCE: UN MYSTÈRE?

- **La conscience fût longtemps considérée comme un problème qu'il est impossible d'étudier scientifiquement:**
  - Dennett: La conscience est un mystère — un problème à propos duquel on ne sait pas encore comment il faut penser.
  - Nagel: La conscience est un phénomène privé, subjectif, à priori inaccessible.
  - Chalmers: La conscience est "le problème difficile" en neurosciences cognitives. Pourquoi sommes-nous conscients?

- **La conscience est maintenant à l'avant-plan du domaine des neurosciences cognitives**
  - Grâce aux méthodes d'imagerie cérébrale comme la tomographie par émission de positons (TEP), la résonance magnétique nucléaire fonctionnelle (RMNf) ou la magnétoencéphalographie, qui permettent de visualiser le cerveau en action, des milliers d'études sont maintenant consacrées à la recherche des "corrélats neuraux de la conscience".

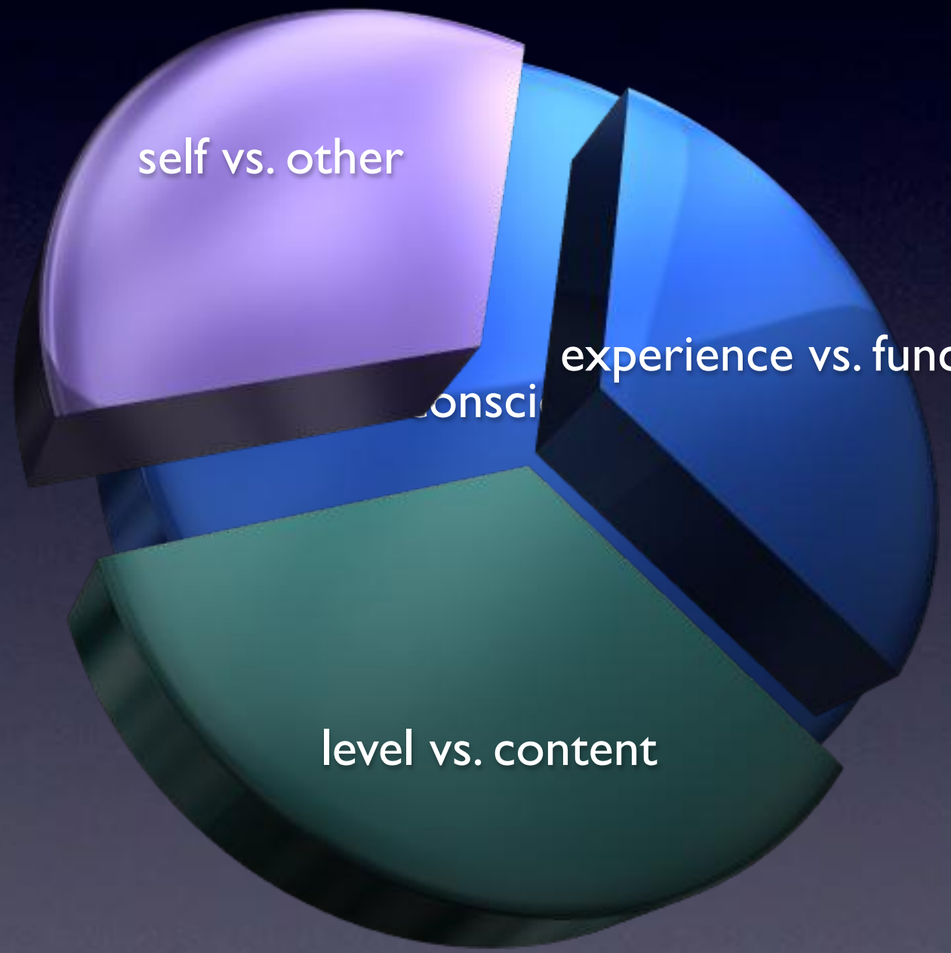
LA RÉSONANCE MAGNETIQUE



MRI measures changes in the regional blood flow that accompanies the metabolic activity of neurons. The method has excellent spatial resolution, which makes it suitable to localize cerebral activity.

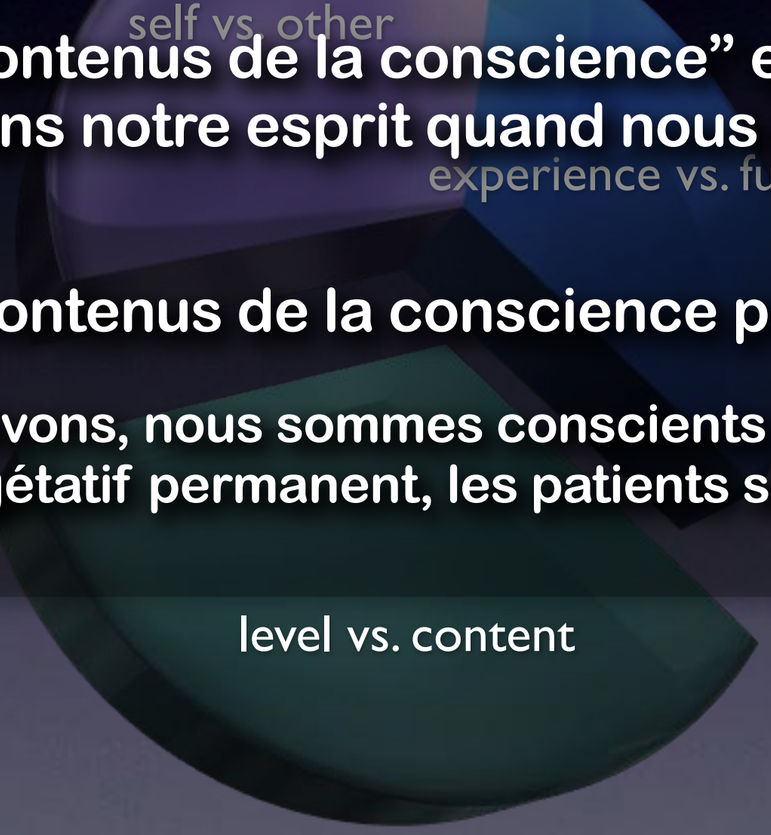
Courtesy Patrick Wilke

LA CONSCIENCE N'EST PAS UNE SEULE CHOSE!



NIVEAUX VS. CONTENUS DE LA CONSCIENCE

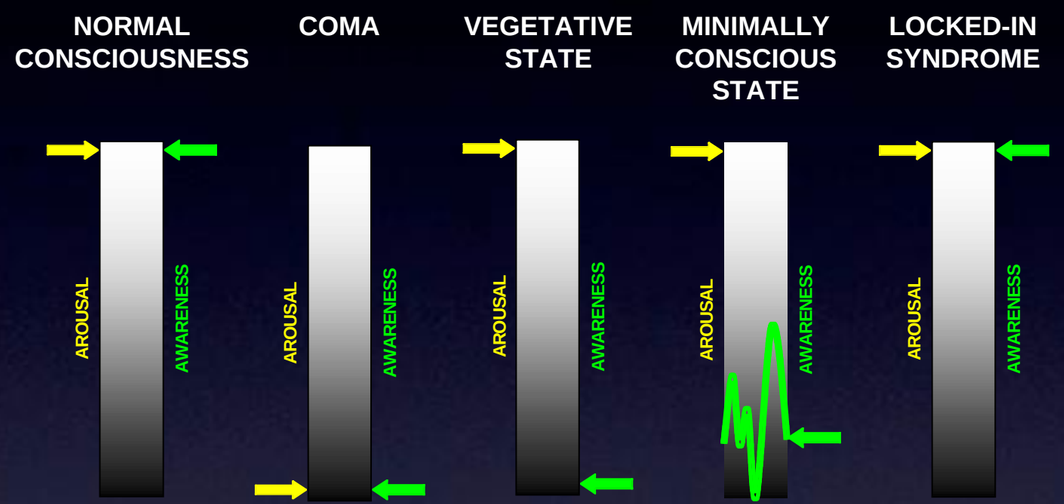
- La notion de “niveau de conscience” est intransitive et se réfère à notre état d’éveil.
- La notion de “contenus de la conscience” est transitive et se réfère à ce qui se passe dans notre esprit quand nous sommes conscients d’un état de choses.



- Etat d’éveil et contenus de la conscience peuvent être dissociés:
  - Quand nous rêvons, nous sommes conscients mais endormis
  - Dans l’état végétatif permanent, les patients sont éveillés mais inconscients

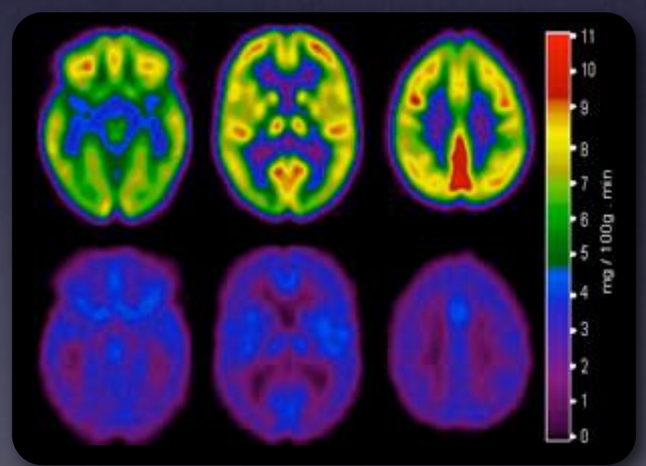
level vs. content

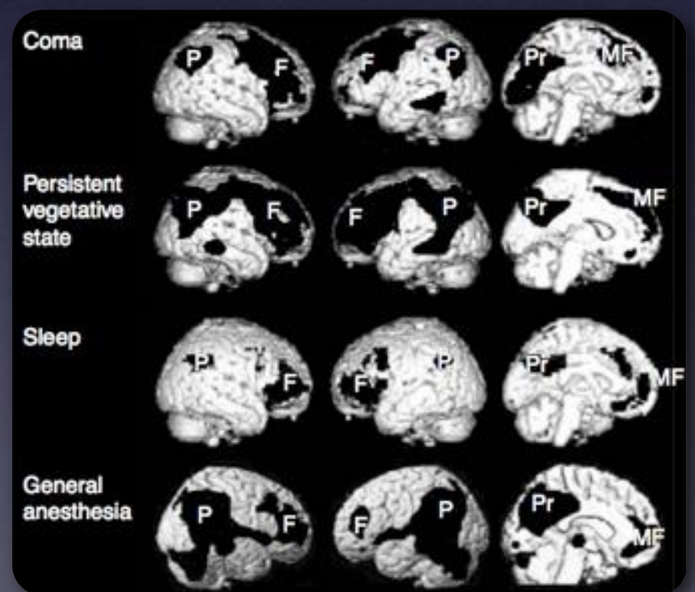
NIVEAUX DE CONSCIENCE



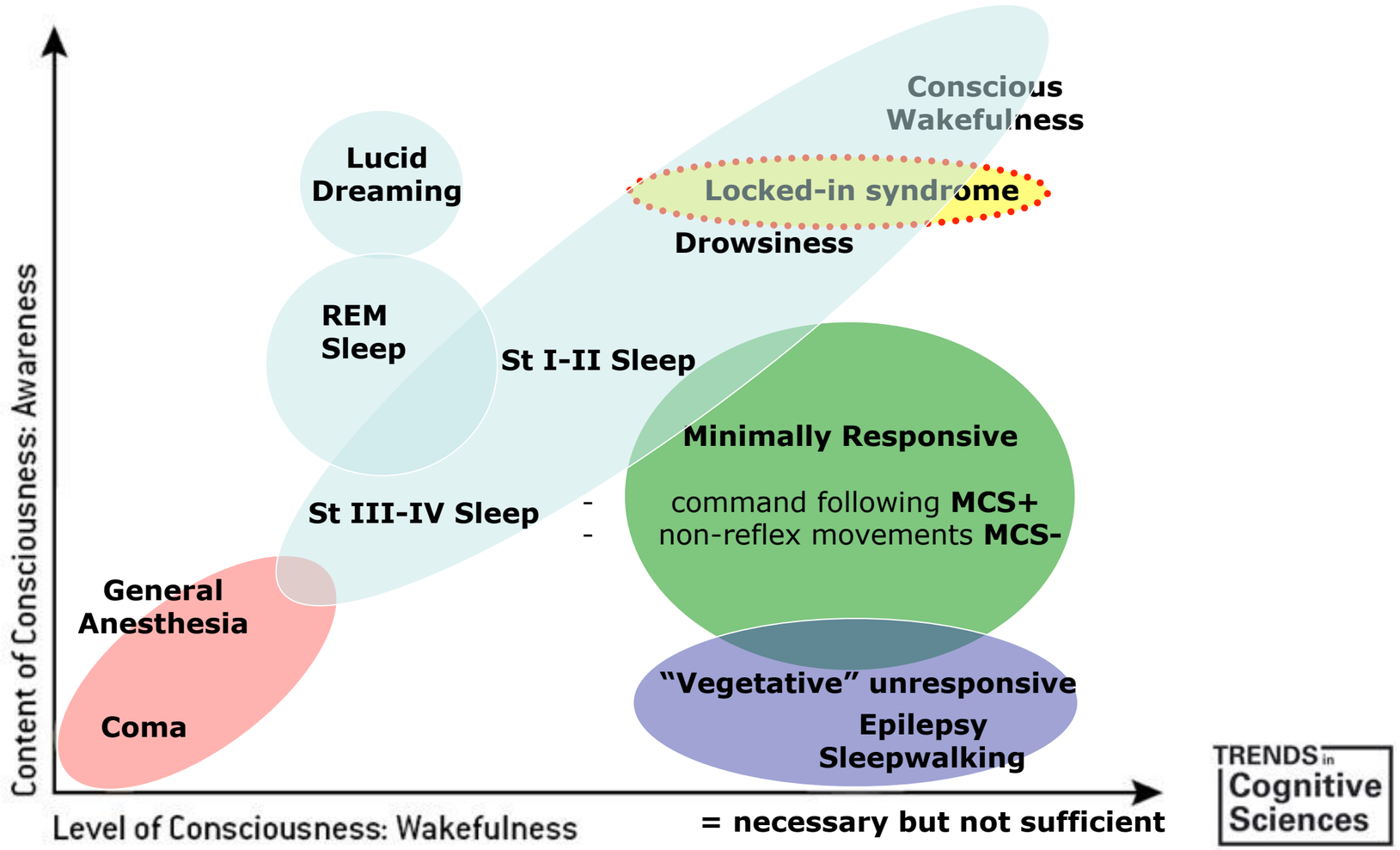
Controls

Vegetative state





Laureys et al.



Laureys, *Trends in Cognitive Sciences,* 2005

www.comascience.org

CONSCIENCE DE SOI ET DES AUTRES

- La conscience n’est pas la même chose que la conscience de soi
- La conscience de soi n’est pas la même chose que la théorie de l’esprit
- Conscience perceptuelle, conscience de soi, et conscience des autres entretiennent des rapports complexes:
  - Neurones miroir
  - Autisme
  - Conscience de soi comme prérequis pour la conscience perceptuelle?
  - Théorie de l’esprit comme prérequis pour la conscience de soi?

RECONNAISSANCE DE SOI

Povinelli et al.

EXPERIENCE VS. FONCTION

- **Conscience d'accès**: Les représentations conscientes sont globalement accessibles pour le contrôle de l'action
- **Conscience phénoménale**: Les représentations conscientes font l'objet d'une expérience, elles sont associées à des qualités vécues

- La question de savoir si les caractéristiques fonctionnelles et phénoménales de la conscience peuvent être dissociées fait l'objet de débats intenses. Est-ce qu'on peut avoir une expérience sans le savoir? Est-ce que l'attention sélectionne certains contenus conscients ou est ce que nous devenons conscients uniquement de ce à quoi nous faisons attention?

LE CERVEAU ET L'ESPRIT

Experience

"downward causation" ?

Comportement

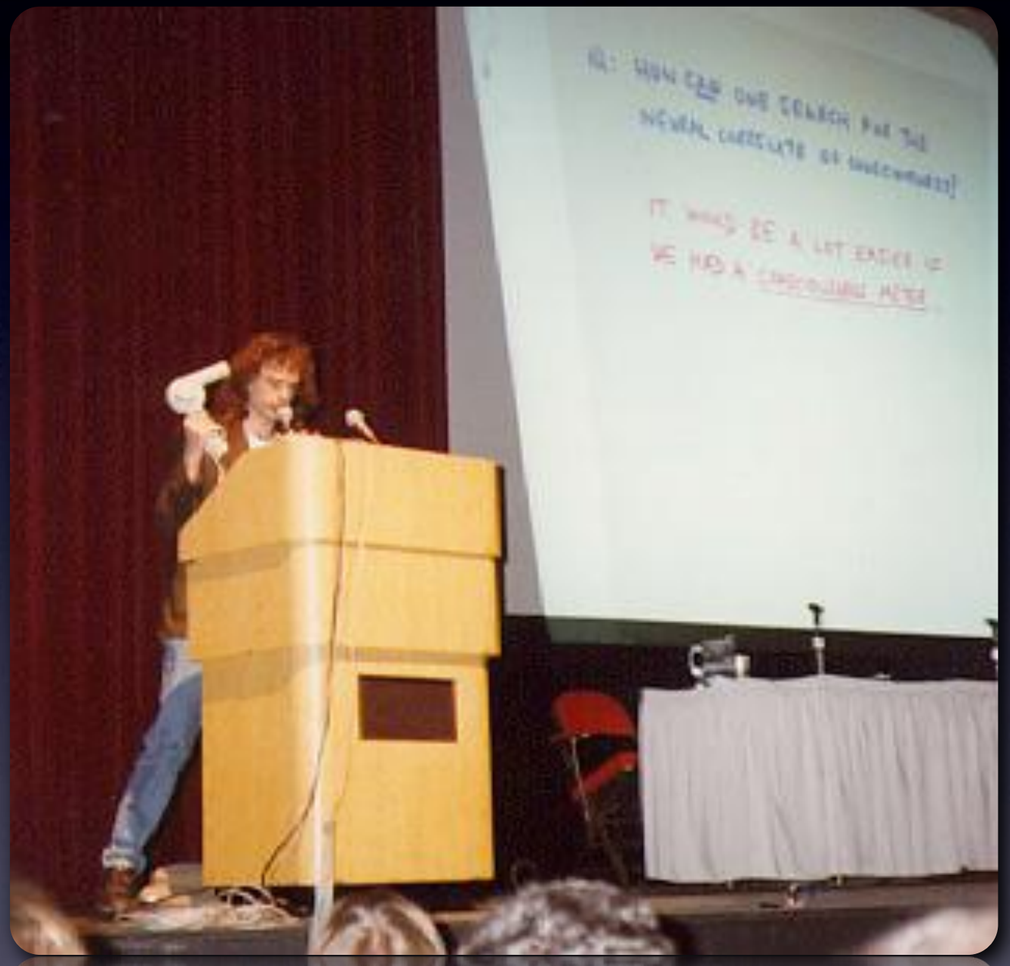
"explanatory gap"

L'étude de la conscience exige que l'on combine données objectives et subjectives

Vers une science de la conscience

Raf Cleeremans

MESURER LA CONSCIENCE



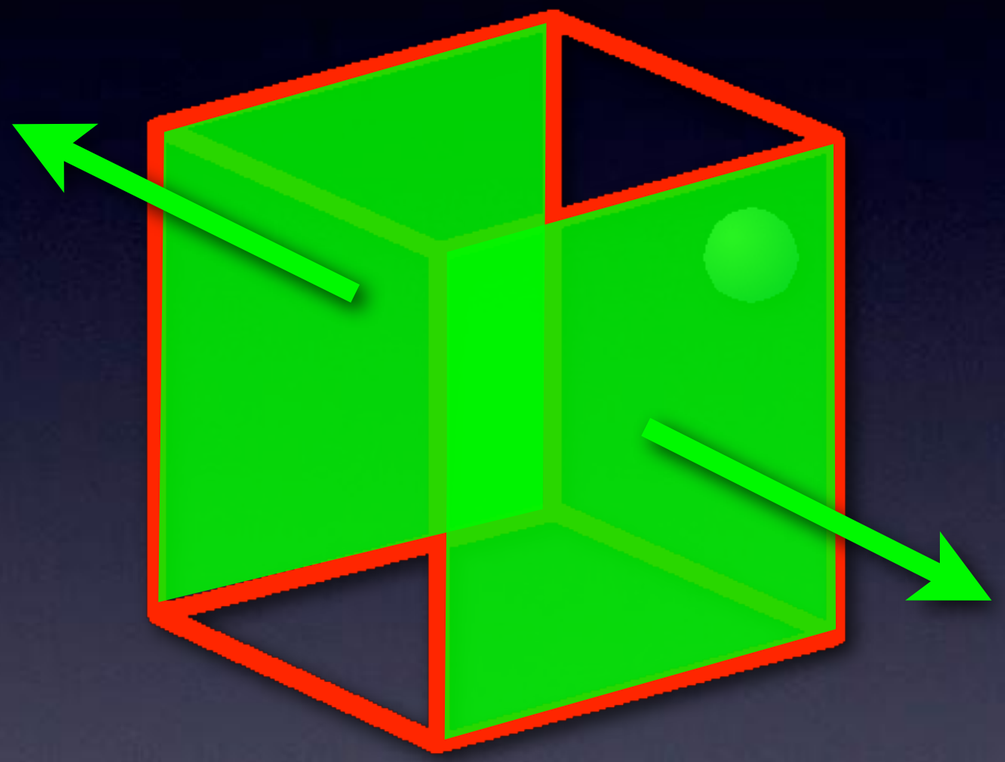
David Chalmers à Tucson II (1996) tenant son "conscience-o-mêtre

LA METHODE CONTRASTIVE

	PERCEPTION	MEMORY	ACTION
Subjective experience changes, stimulation & behavior remain constant	Binocular rivalry	Episodic Recall	Awareness of intention
	Hallucinations	Confabulation	Delusion of control
Subjective experience remains constant, stimulation changes	Stimulation changes without awareness	Unrecognized “old” items	action without awareness
	Blindsight	Unrecognized items in amnesia	Stimuli eliciting unintended action
Subjective experience remains constant, behavior changes	Correct guessing without awareness	Implicit learning	Implicit motor behaviour
	Correct reaching in form-agnosia	Implicit learning in amnesia	Unintended action

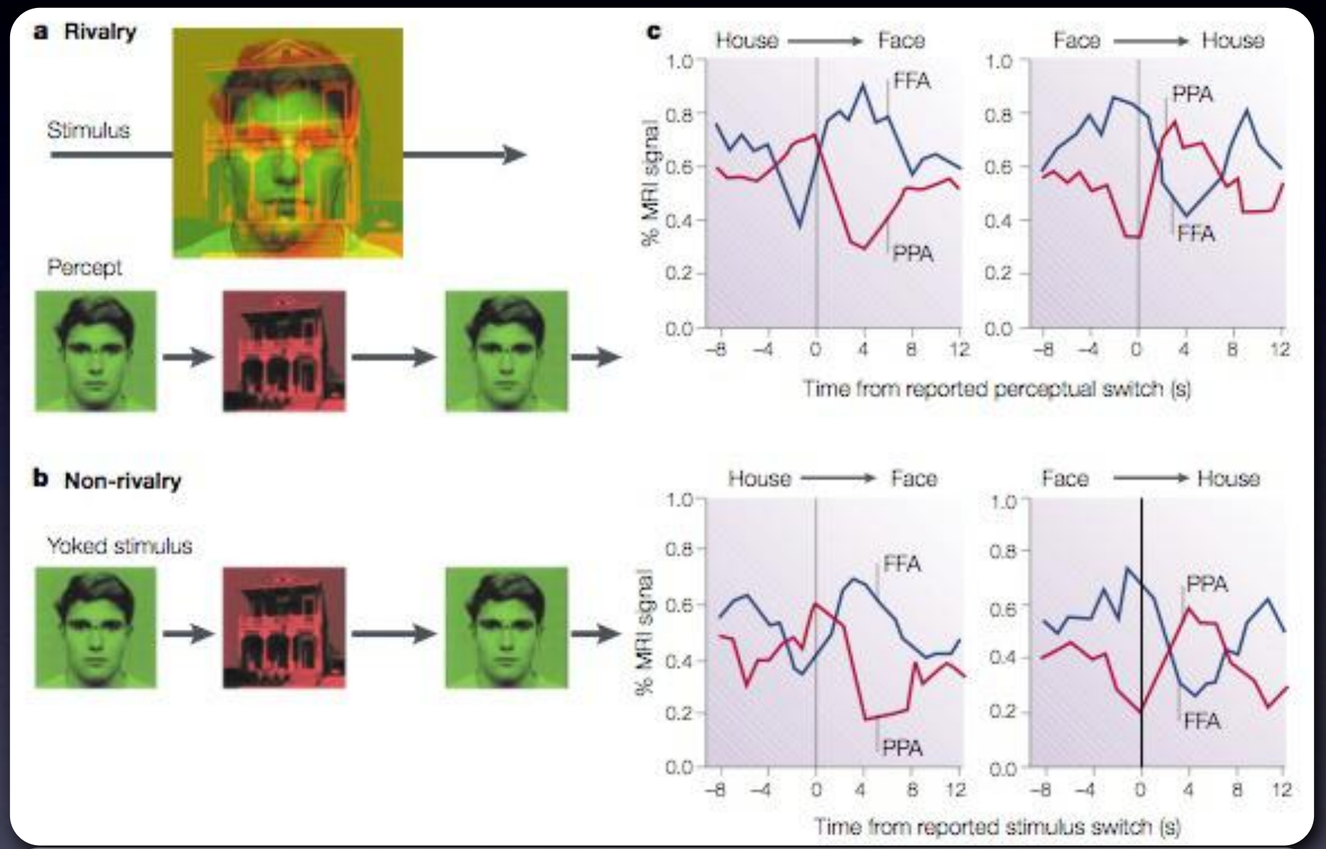
Lumer et al.

UNE FIGURE AMBIGÜE



LE CUBE DE NECKER

LA RIVALITÉ BINOCULAIRE



Face-specific or place-specific areas of the brain activate as a function of people's momentary conscious experience of an unchanging stimulus.

Kanwisher et al.

LA METHODE CONTRASTIVE

	PERCEPTION	MEMORY	ACTION
Subjective experience changes, stimulation & behavior remain constant	Binocular rivalry	Episodic Recall	Awareness of intention
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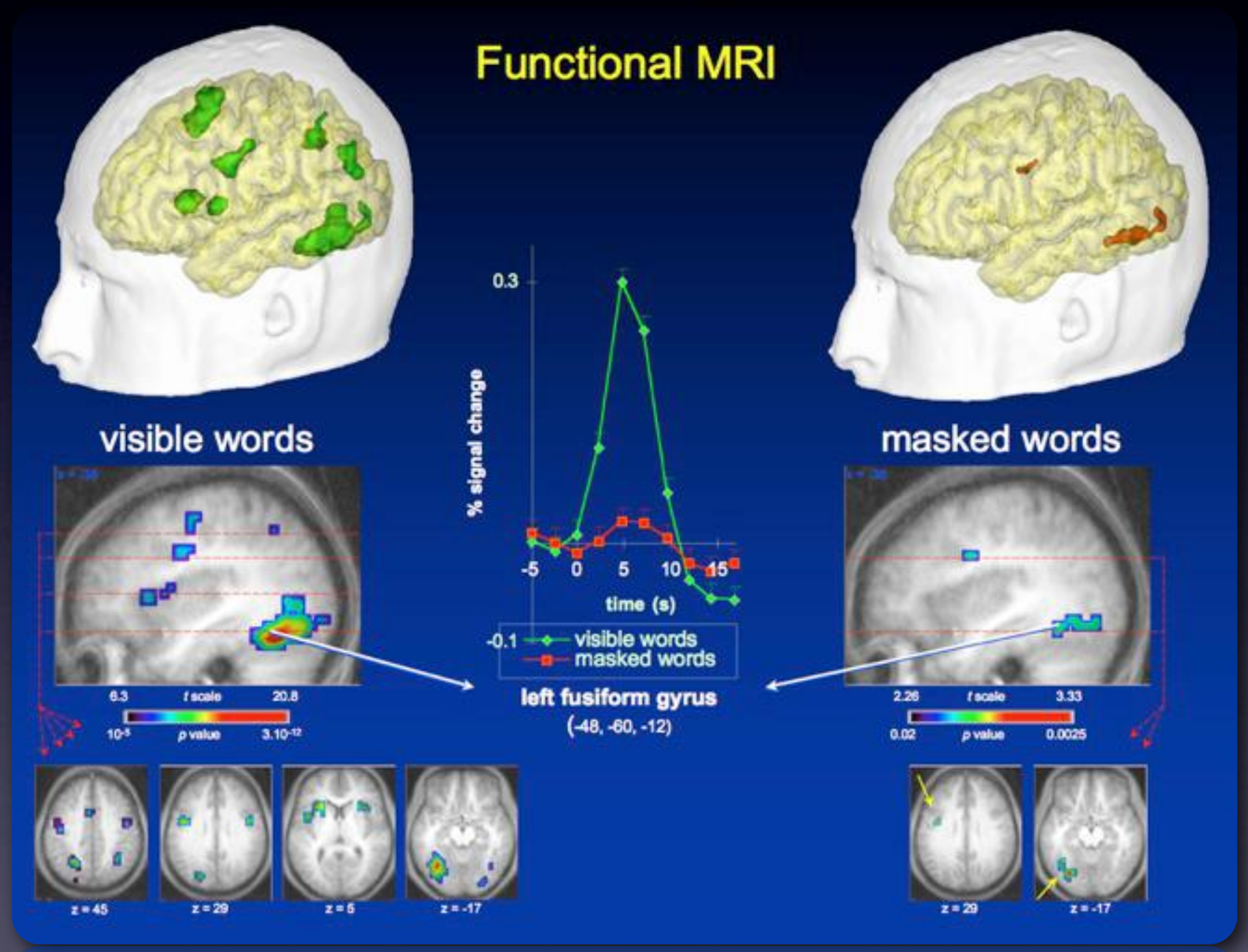
Subjective experience remains constant, behavior changes	Correct guessing without awareness	Implicit learning	Implicit motor behaviour
	Correct reaching in form-agnosia	Implicit learning in amnesia	Unintended action

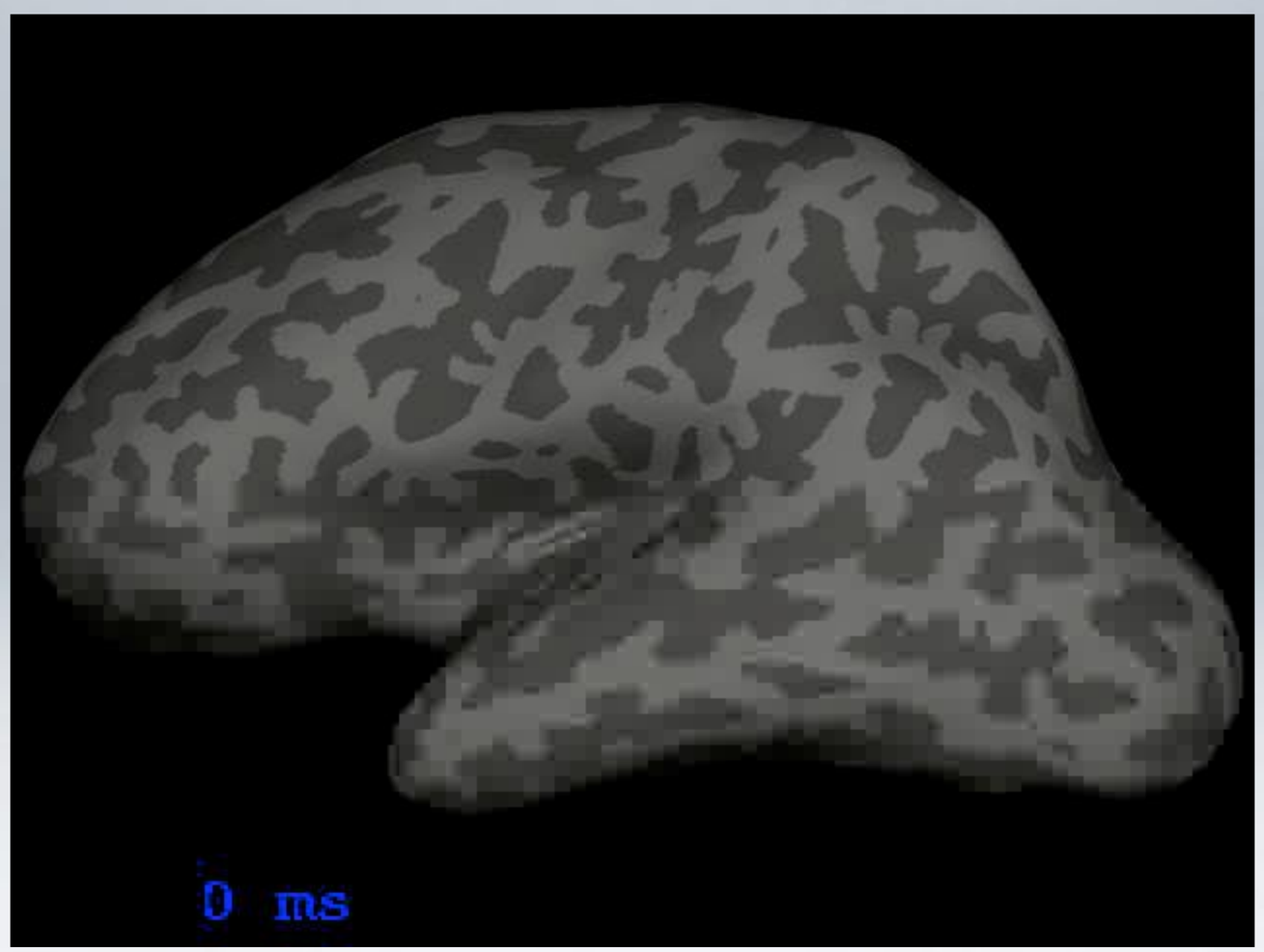
Lumer et al.

LA PERCEPTION SUBLIMINALE



Dehaene et al.

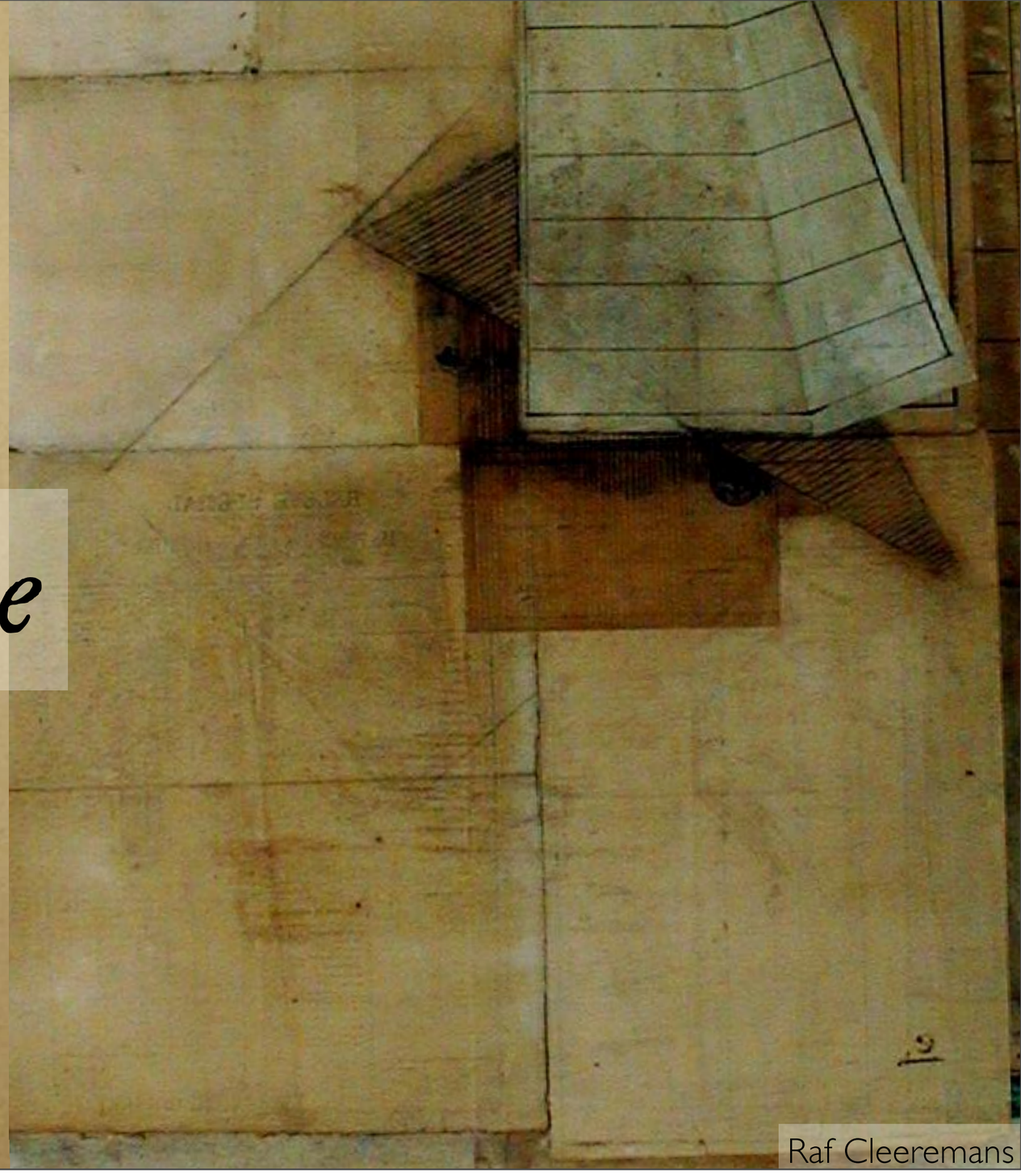
DYNAMIQUE TEMPORELLE DE LA CONSCIENCE



LA VISION AVEUGLE

De Gelder et al. (2008). Current Biology 18, R1128-R1129

Theories de la conscience



Raf Cleeremans

TWO BIG IDEAS

"higher-order thoughts"

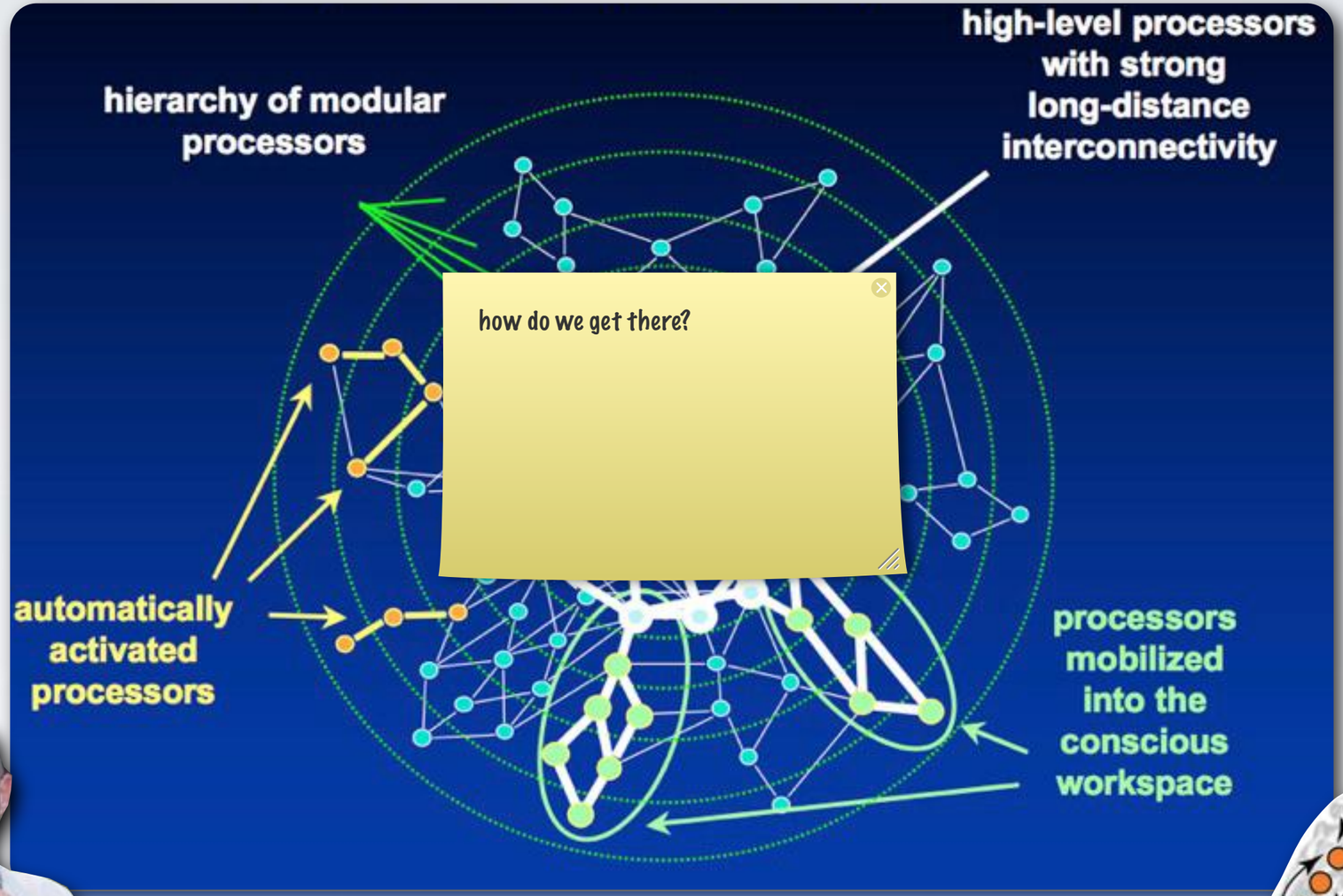
"fame in the brain"

FAME IN THE BRAIN

- Many proposed neural or computational correlates of consciousness converge towards "fame in the brain"
  - Adaptive Resonance (Grossberg)
  - Integration & differentiation (Tononi)
  - recurrence & reentrant processing (Lamme)
  - stability in time (O'Brien & Opie)
  - synchrony (Crick & Koch)
  - Global broadcast (Baars, Dehaene)

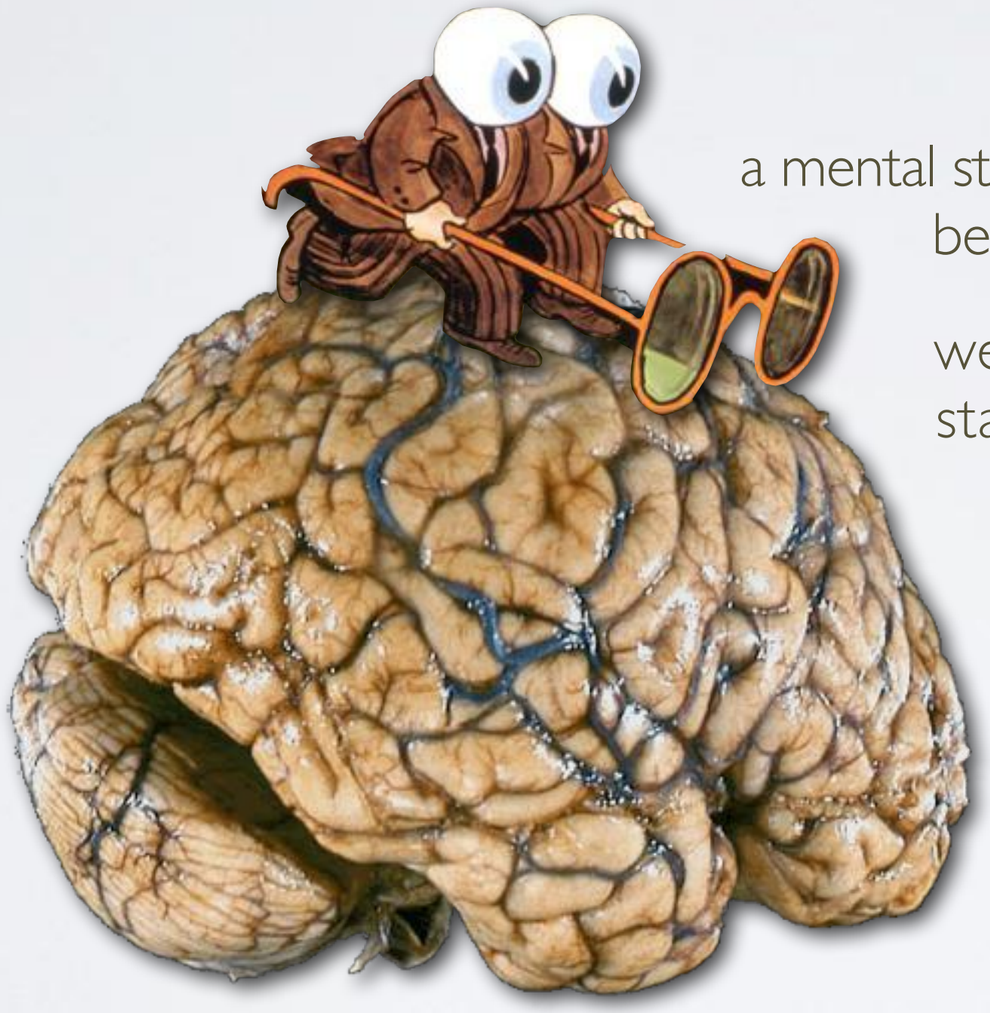
Atkinson, Thomas & Cleeremans, TiCS (2000); Maia & Cleeremans, TiCS(2005)

THE NEURAL WORKSPACE



HIGHER-ORDER THOUGHTS

ROSENTHAL 1986, 2004



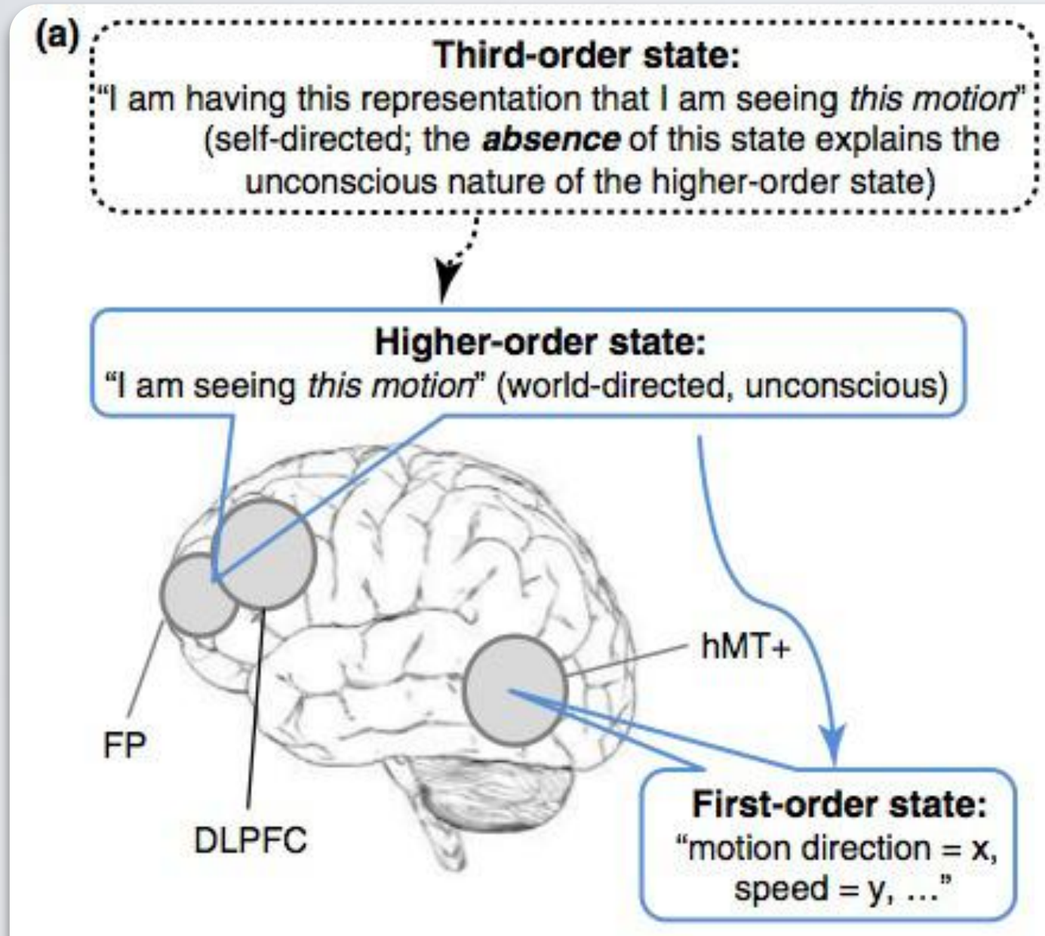
a mental state is conscious if we are conscious of being in that mental state;

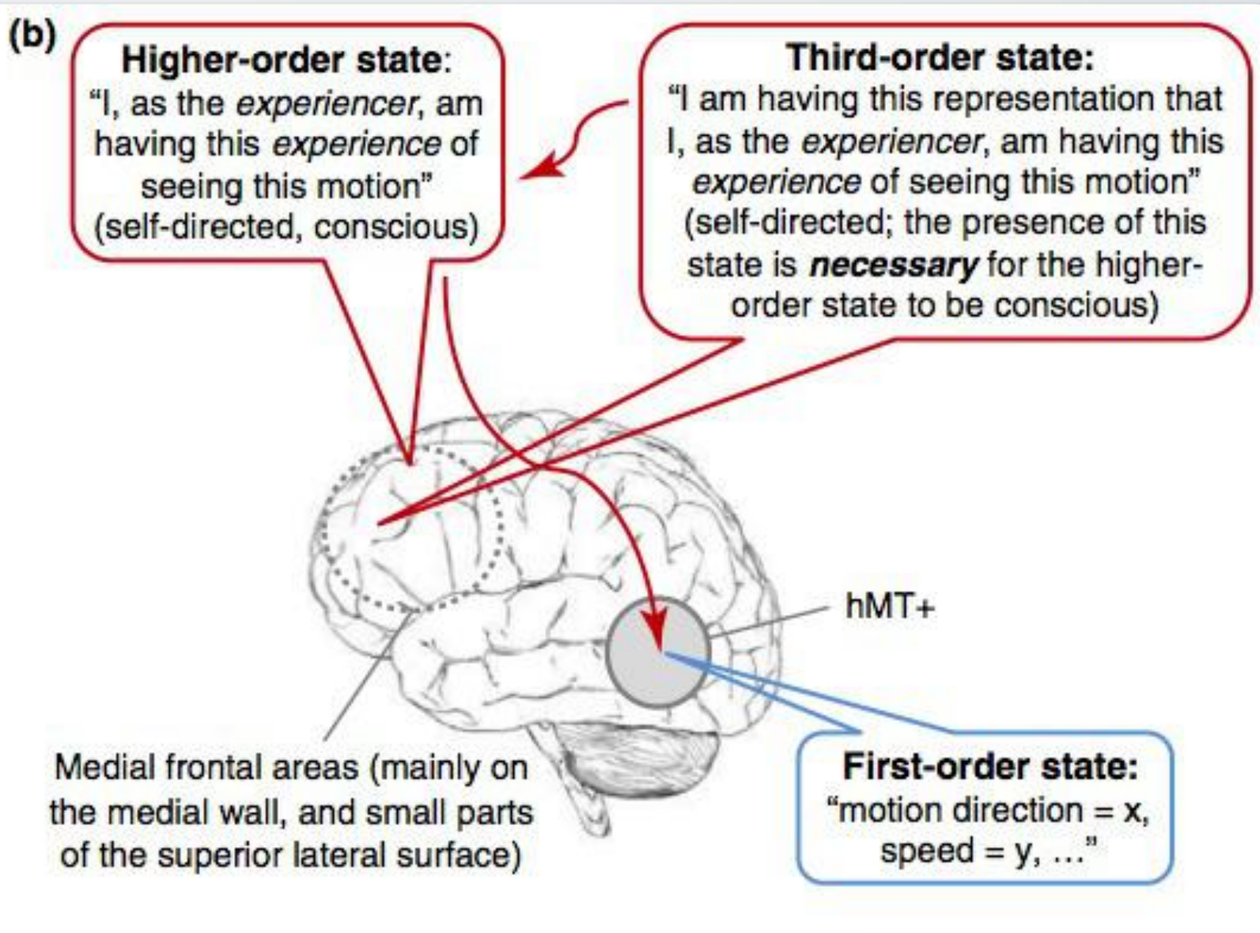
we are conscious of being in a mental state when we have a thought that we are in that mental state;

in sum, a mental state is a conscious mental state in virtue of having a higher order thought that you yourself are in that mental state.

HIGHER-ORDER THOUGHTS

LAU & ROSENTHAL, TICS 2011

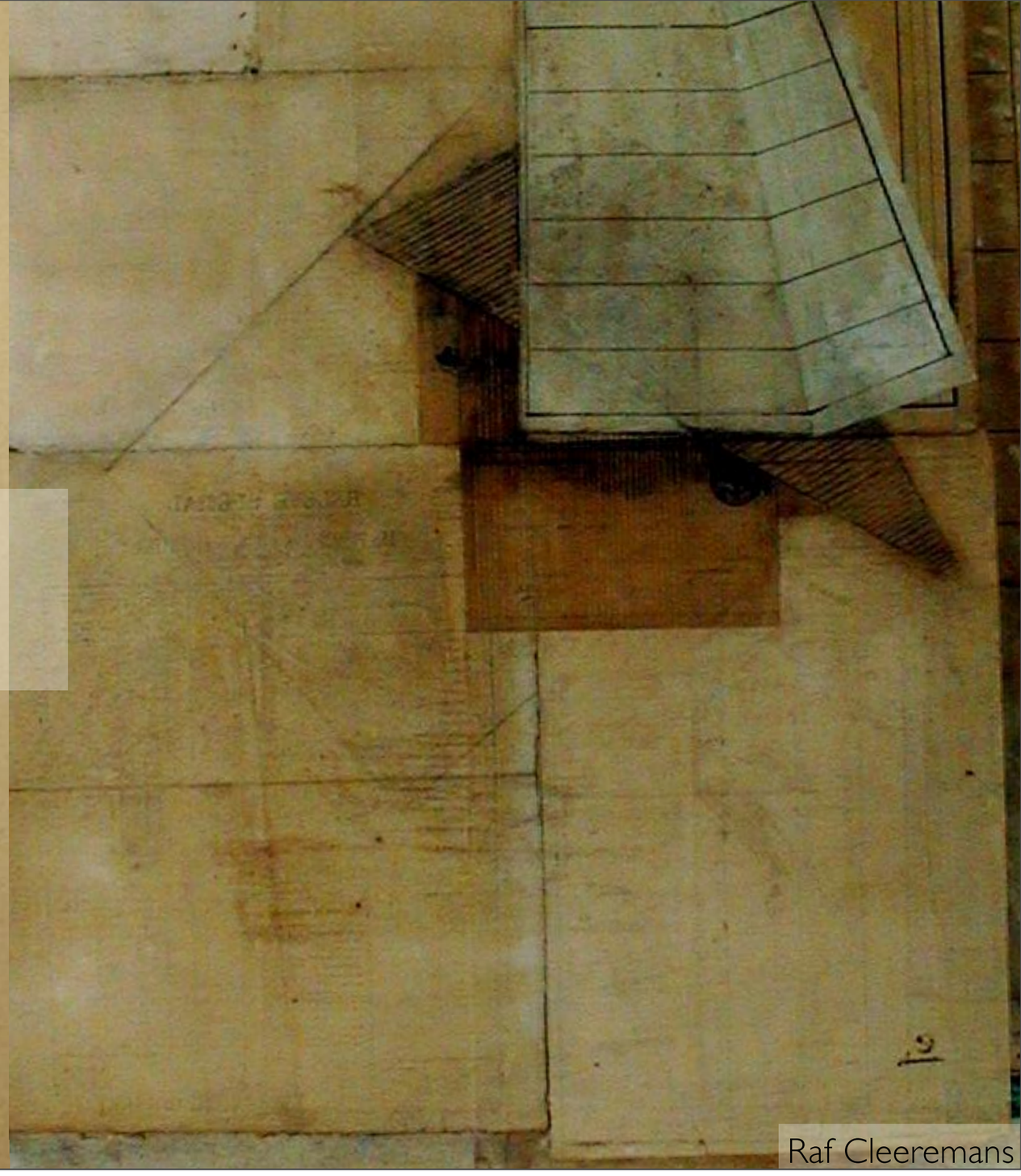




TRENDS in Cognitive Sciences

Correct **Incorrect**

L'état végétatif



Raf Cleeremans

L'ÉTAT VÉGETATIF

- Importance du syndrome pour la recherche fondamentale
- Importance de la recherche fondamentale pour la prise en charge des patients
  - recherche sur les échelles diagnostiques (mesures subjectives)
  - recherche sur les corrélats neuraux

Atkinson, Thomas & Cleeremans, TiCS (2000); Maia & Cleeremans, TiCS(2005)

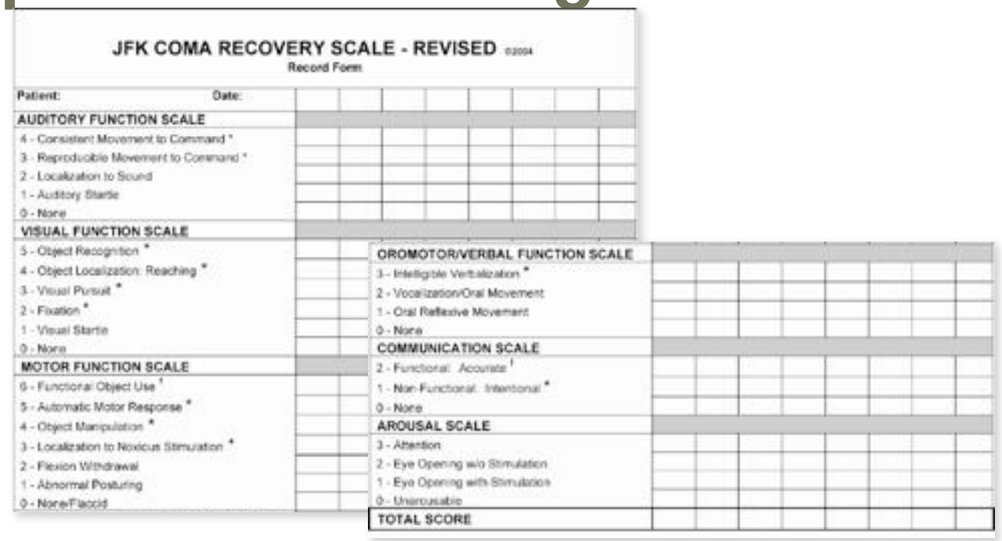
Diagnostic errors

n=103 post-comatose patients

– 45 clinical consensus diagnosis ‘vegetative state’

– 18 signs of awareness (Coma Recovery Scale)

40% potential misdiagnosis



JFK COMA RECOVERY SCALE - REVISED ©2004
Record Form

Patient: Date:

AUDITORY FUNCTION SCALE									
4 - Consistent Movement to Command *									
3 - Reproducible Movement to Command *									
2 - Localization to Sound									
1 - Auditory Startle									
0 - None									
VISUAL FUNCTION SCALE									
5 - Object Recognition *									
4 - Object Localization: Reaching *									
3 - Visual Pursuit *									
2 - Fixation *									
1 - Visual Startle									
0 - None									
MOTOR FUNCTION SCALE									
6 - Functional Object Use †									
5 - Automatic Motor Response *									
4 - Object Manipulation *									
3 - Localization to Noxious Stimulation *									
2 - Flexion Withdrawal									
1 - Abnormal Posturing									
0 - None/Flaccid									
OROMOTOR/VERBAL FUNCTION SCALE									
3 - Intelligible Verbalization *									
2 - Vocalization/Oral Movement									
1 - Oral Reflexive Movement									
0 - None									
COMMUNICATION SCALE									
2 - Functional: Accurate †									
1 - Non-Functional: Intentional *									
0 - None									
AROUSAL SCALE									
3 - Attention									
2 - Eye Opening w/o Stimulation									
1 - Eye Opening with Stimulation									
0 - Unarousable									
TOTAL SCORE									

Schnakers et al, *BMC Neurology* 2009

Coma Recovery Scale-Revised

SELF-STUDY DVD OFFER

COMA RECOVERY SCALE - REVISED: GUIDELINES FOR ADMINISTRATION AND SCORING

coma@ulg.ac.be

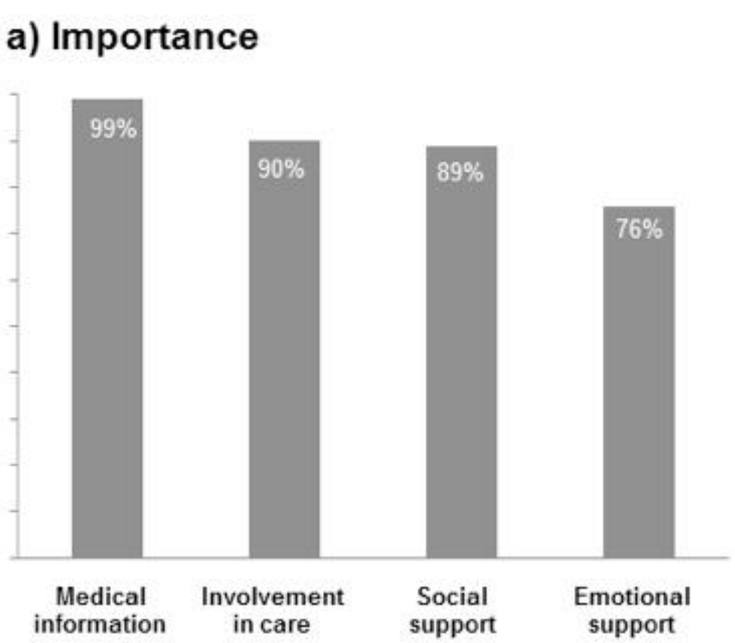
Université de Liège

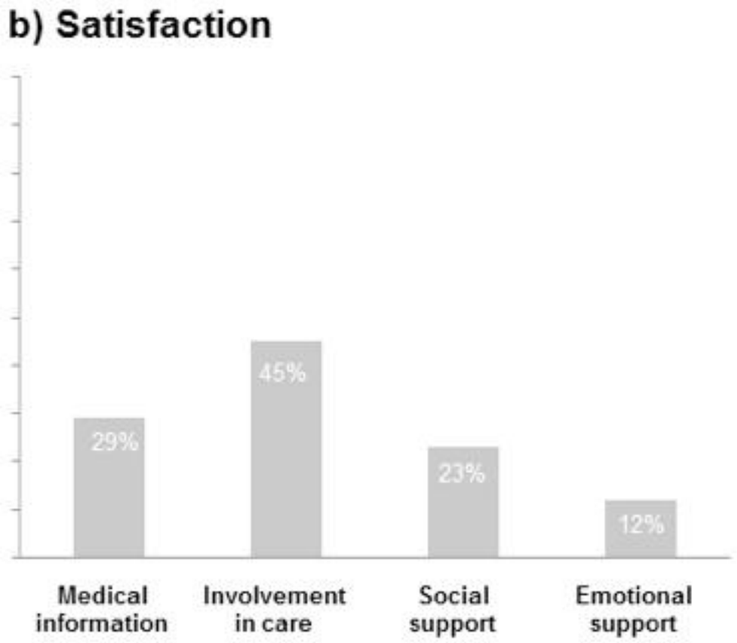
CHU de Liège

JFK MEDICAL CENTER

www.comascience.org

Family needs

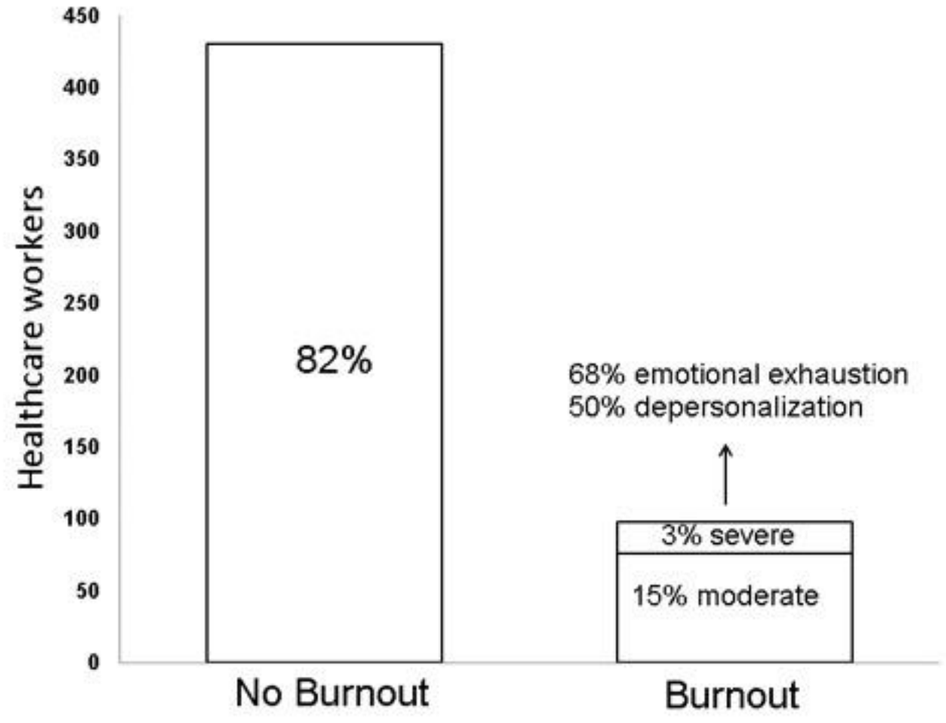




Gosseries et al, *submitted*

Burnout in caregivers

568 health care workers (Maslach Burnout Inventory)



Profession	Burnout
Physician	8%
Nurse	24%
Nursing assistant	23%
Physio-/speech-/ergo-therapist	8%
Psychologist/social worker	10%

Gosseries, Demertzi et al, *Brain Injury* 2012

A new name for “vegetative”

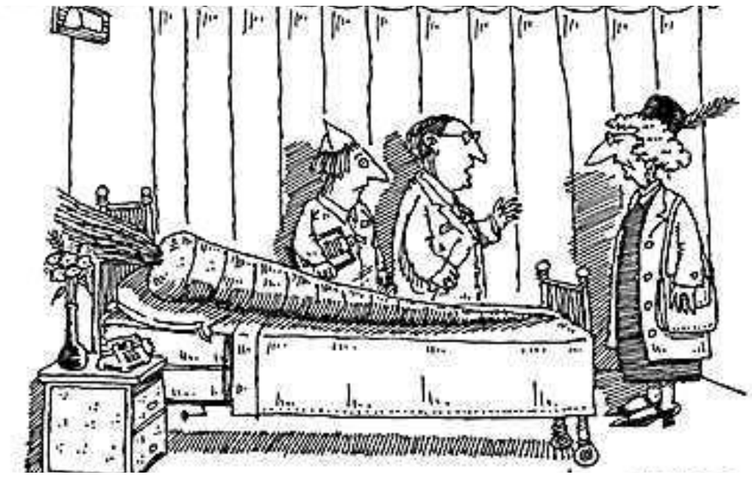
BMC Medicine

Highly accessed Open Access

Unresponsive wakefulness syndrome: a new name for the vegetative state or apallic syndrome

Steven Laureys[1], **Gastone G Celesia**[2], **Francois Cohadon**[3], **Jan Lavrijsen**[4], **José León-Carrión**[5], **Walter G Sannita**[6,7], **Leon Sazbon**[8], **Erich Schmutzhard**[9], **Klaus R von Wild**[10,11], **Adam Zeman**[12] and **Giuliano Dolce**[13] for **the European Task Force on Disorders of Consciousness**[1]

http://www.biomedcentral.com/1741-7015/8/68

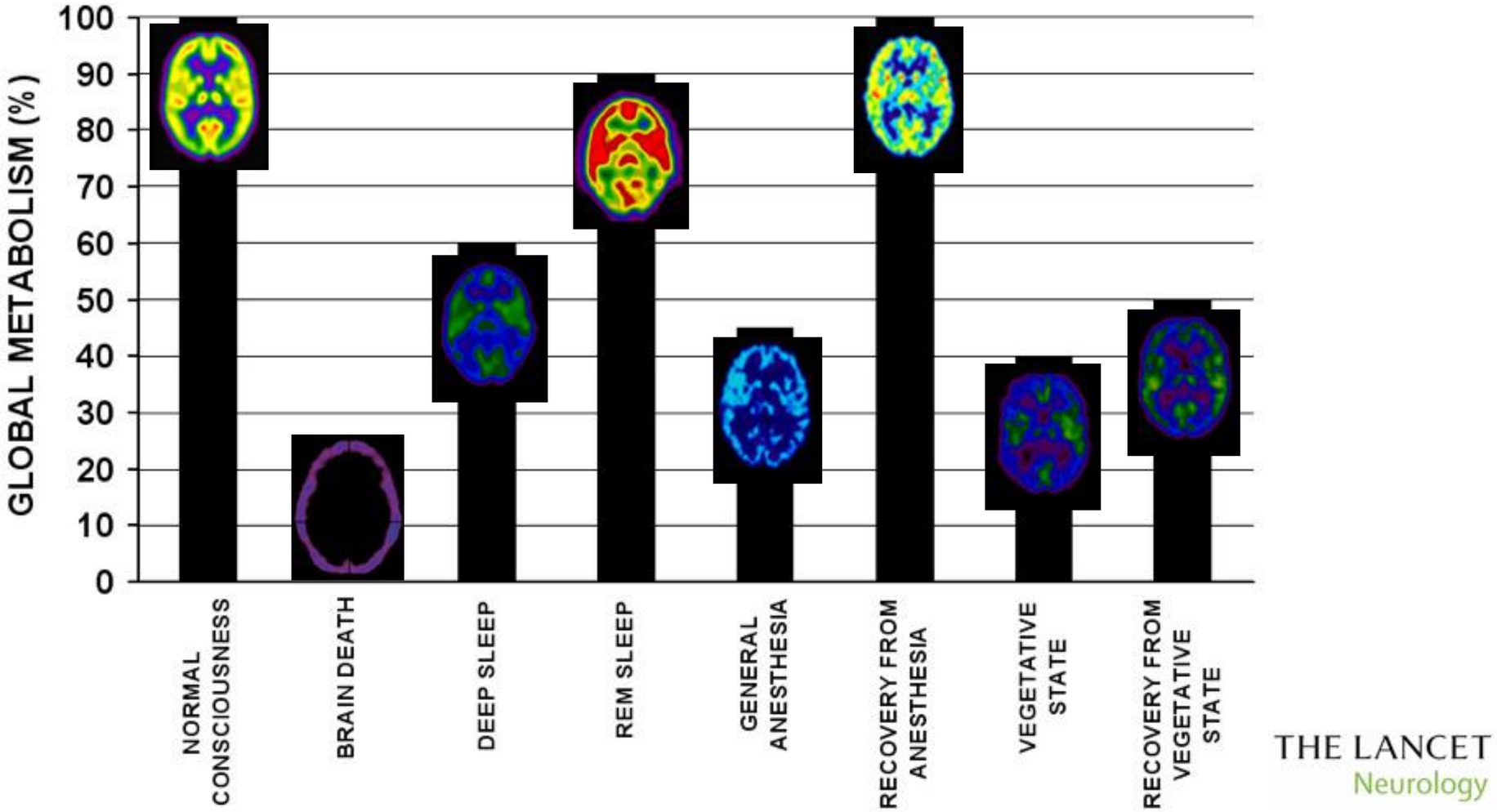


“There’s nothing we can do… he’ll always be a vegetable.”

Laureys et al, *BMC Medicine* 2011

www.comascience.org

Consciousness ≠ global brain function

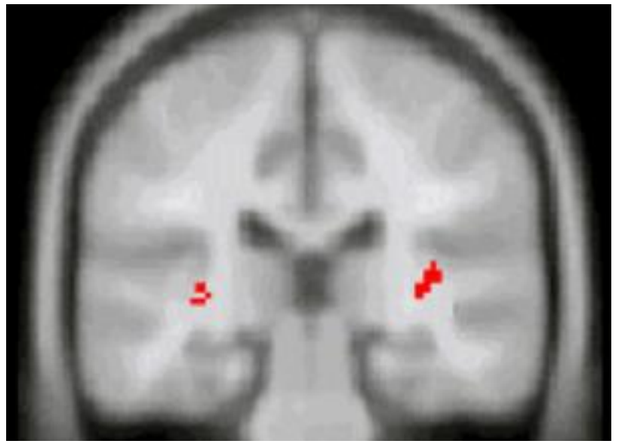


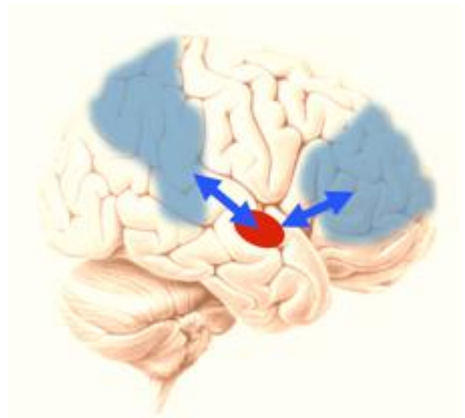
Laureys et al., Lancet Neurology, 2004

www.comascience.org

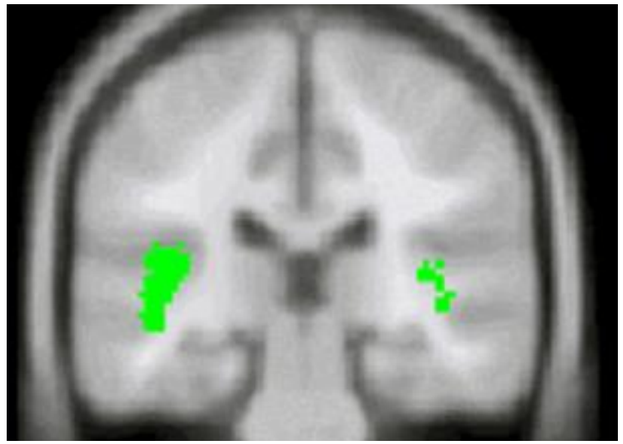
Consciousness ≠ primary cortex

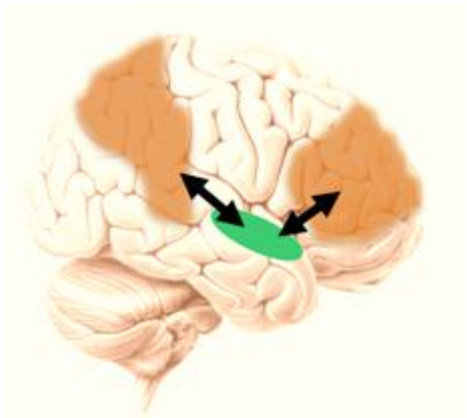
"VEGETATIVE"
UNRESPONSIVE





MINIMALLY
RESPONSIVE



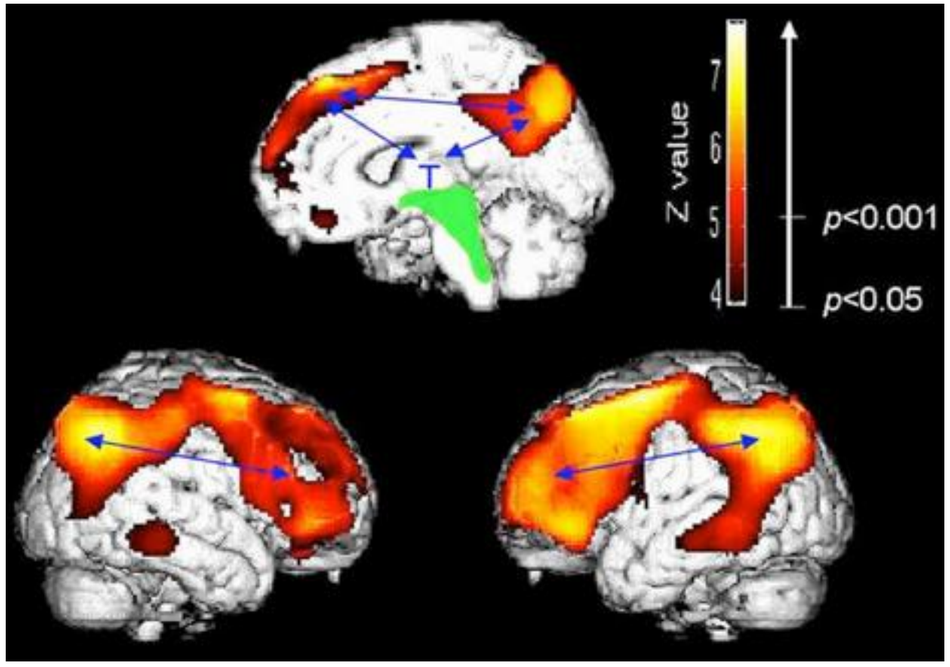


Laureys et al, *Brain,* 2000
Boly et al*, Archives of Neurology,* 2004

www.comascience.org

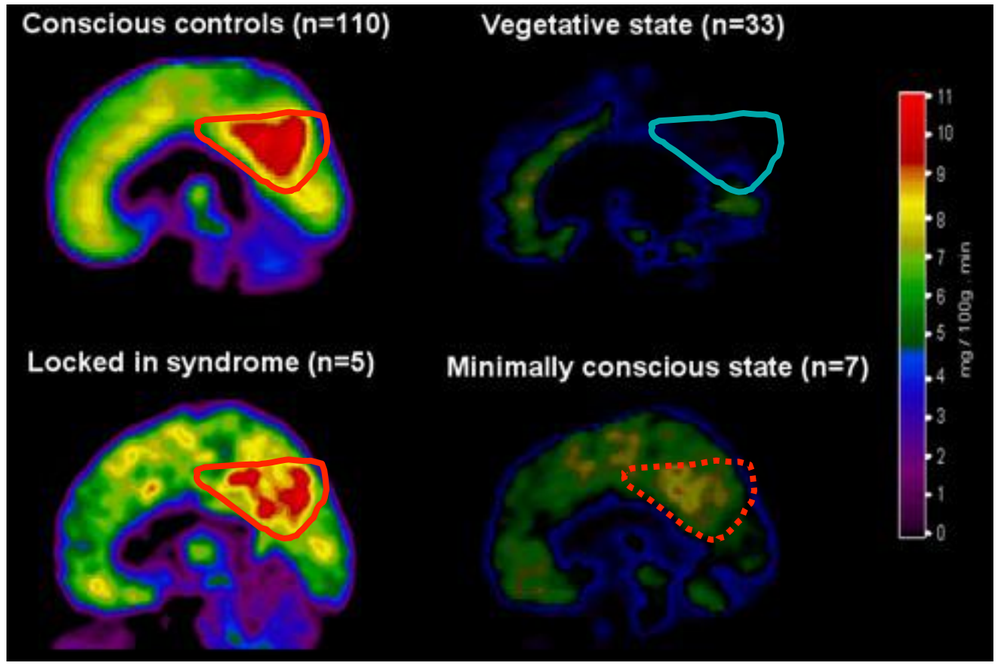
Consciousness ≈ frontoparietal

Areas systematically dysfunctional in “vegetative” state & recovering activity after recovery of consciousness



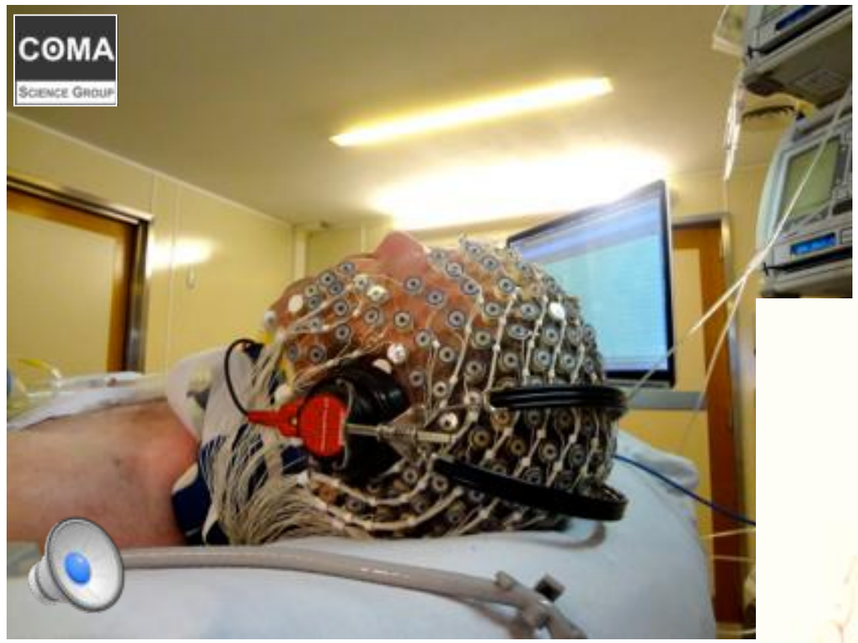
Laureys et al, *Neuroimage* 1999
Laureys et al, *J Neurol Neurosurg Psychiatry,* 1999

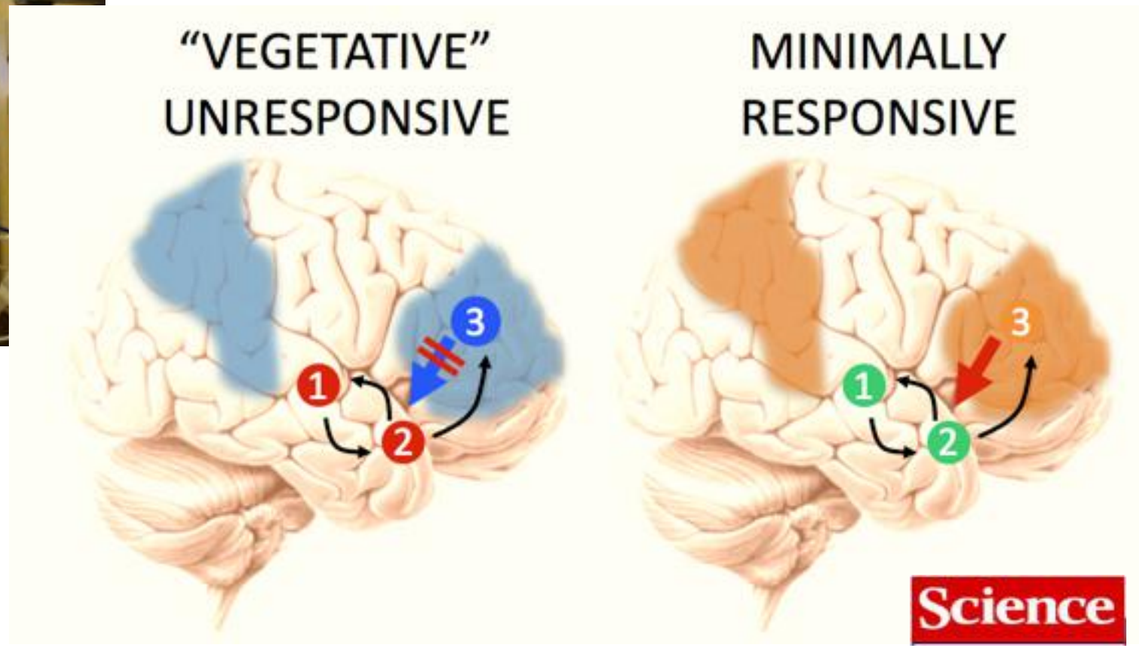
Precuneus is critical hub in fronto-parietal connectivity



Laureys et al, *Lancet Neurology,* 2004

Consciousness ≈ top-down



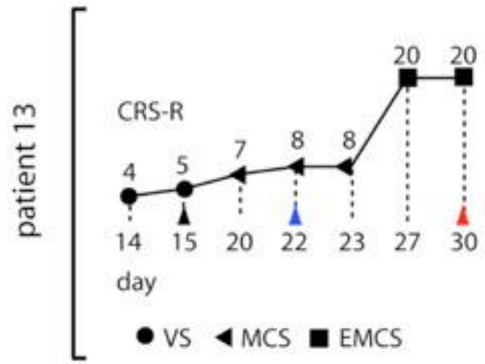


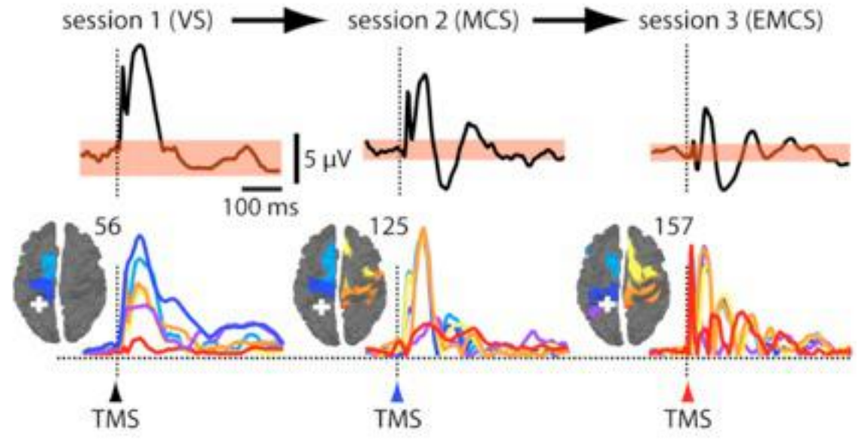
Boly, Garrido, Gosseries, Bruno, Schnakers, Massimini, Litvak, Laureys, Friston, *Science*, 2011

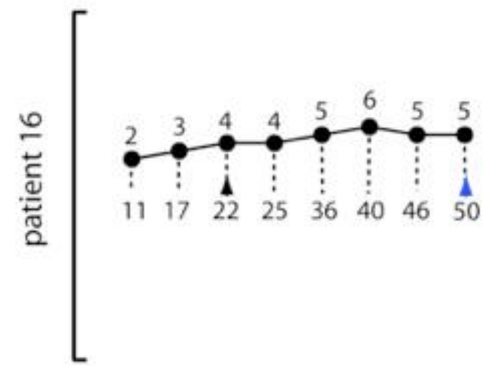
www.comascience.org

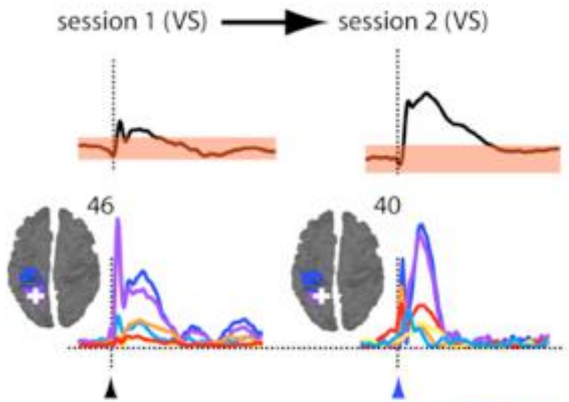
Consciousness ≈ connectivity

EEG-TMS









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A JOURNAL OF NEUROLOGY

CHU de Liège

UNIVERSITÀ DEGLI STUDI DI MILANO

Rosanova and Gosseries et al, *Brain* 2012

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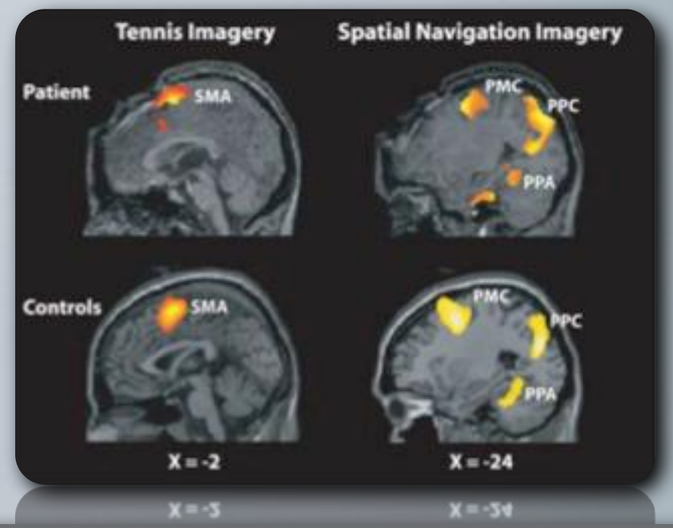
LE SYNDROME "LOCKED-IN"



BREVIA

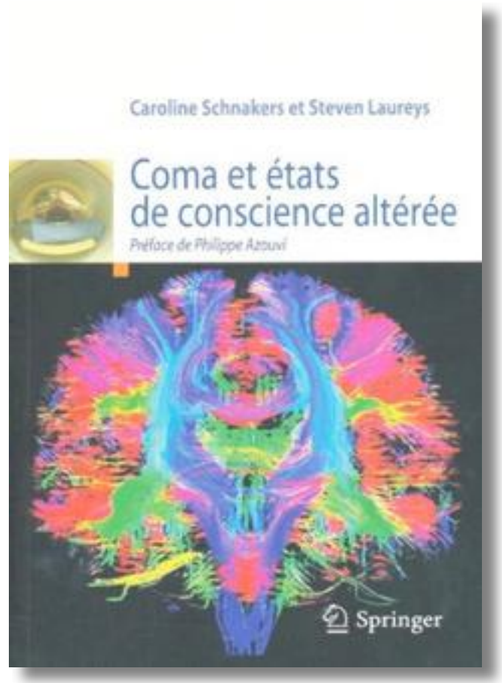
Detecting Awareness in the Vegetative State

Adrian M. Owen,[1]* Martin R. Coleman,[2] Melanie Boly,[3] Matthew H. Davis,[1] Steven Laureys,[3] John D. Pickard[2]

Steven Laureys et al.

Challenges

1. Epidemiology
   - centralized database
2. Diagnosis
   - standardized assessment (CRS-R)
3. Prognosis
   - fMRI (resting state), MRI DTI, EEG, ERP
4. Treatment
   - sensory stimulation, amantadine, zolpidem, DCS, deep brain stim
5. Adapted network for VS/UWS-MCS
   - improve medical care & ethical decision-making



RADICAL PLASTICITY!

Brain of a white-collar worker

Lionel Feuillet, Henry Dufour, Jean Pelletier

Lancet 2007; 370: 262

Department of Neurology (L Feuillet MD, J Pelletier PhD), **and Department of Neurosurgery** (H Dufour PhD), **Faculté de Médecine de Marseille, Université de la Méditerranée, Assistance Publique hôpitaux de Marseille—Hôpital de la Timone, Marseille, France**

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A 44-year-old man presented with a 2-week history of mild left leg weakness. At the age of 6 months, he had undergone a ventriculoatrial shunt, because of postnatal hydrocephalus of unknown cause. When he was 14 years old, he developed ataxia and paresis of the left leg, which resolved entirely after shunt revision. His neurological development and medical history were otherwise normal. He was a married father of two children, and worked as a civil servant. On neuropsychological testing, he proved to have an intelligence quotient (IQ) of 75: his verbal IQ was 84, and his performance IQ 70. CT showed severe dilatation of the lateral ventricles (figure); MRI revealed massive enlargement of the lateral, third, and fourth ventricles, a very thin cortical mantle and a posterior fossa cyst. We diagnosed a non-communicating hydrocephalus, with probable stenosis of Magendie's foramen (figure). The leg weakness improved partly after neuroendoscopic ventriculocisternostomy, but soon recurred; however, after a ventriculoperitoneal shunt was inserted, the findings on neurological examination became normal within a few weeks. The findings on neuropsychological testing and CT did not change.

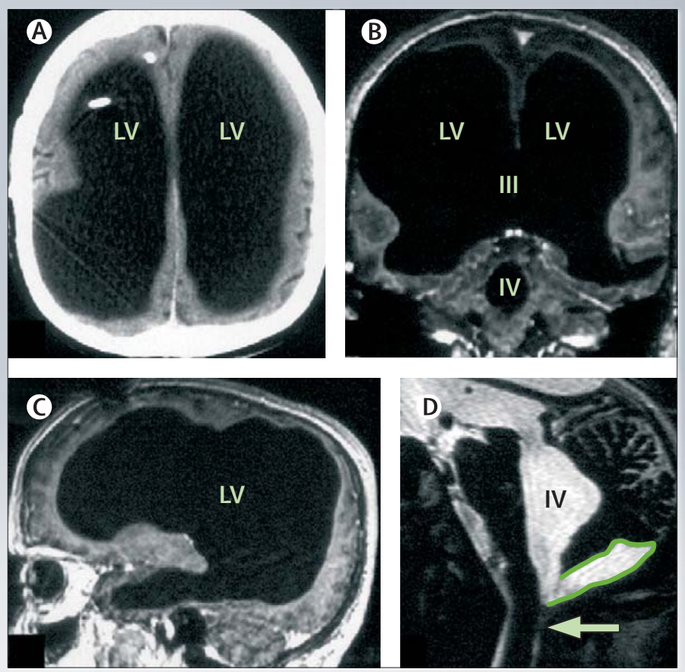


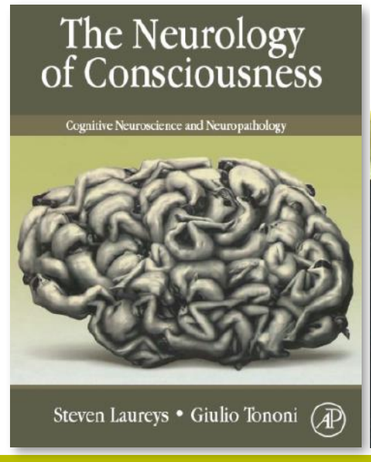
Figure: **Massive ventricular enlargement, in a patient with normal social functioning**
(A) CT; (B, C) T1- weighted MRI, with gadolinium contrast; (D) T2-weighted MRI. LV=lateral ventricle. III=third ventricle. IV=fourth ventricle. Arrow=Magendie's foramen. The posterior fossa cyst is outlined in (D).

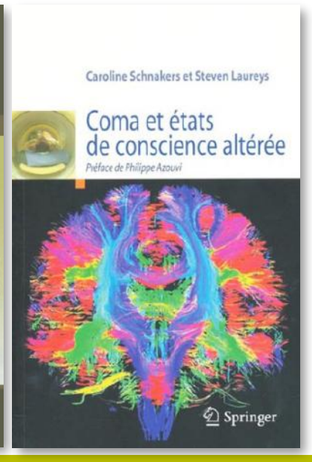
CONCLUSIONS

La conscience est un des défis scientifiques les plus importants aujourd'hui, un problème auquel on ne sait pas encore comment il faut penser.

Aborder scientifiquement explorer la conscience exige une approche interdisciplinaire grâce à laquelle on peut corréler des données objectives (le cerveau en action) et des données subjectives (l'effet que cela fait) de manière à contraster ce qui se passe avec et sans conscience.

L'état végétatif est non seulement important du point de vue de la recherche fondamentale mais également en termes de prise en charge des patients (40% de diagnostics erronés) et de leur entourage.





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DISCUSSION