

COMA

SCIENCE GROUP



# CRS-R WORKSHOP

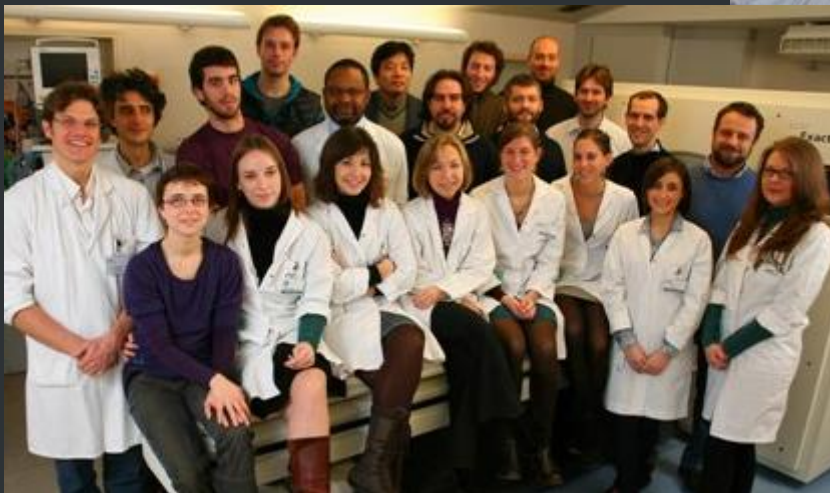
Coma Science Group  
GIGA Research Center  
University of Liège



January 19<sup>th</sup> 2018



# Coma Science Group – GIGA Consciousness



<http://www.comascience.org/>

# OUTLINE

## Introduction

- What is « consciousness » ?
- Disorders of consciousness
- Behavioral scales

## Coma Recovery Scale – Revised

- Presentation of 23 items and 6 subscales
- Brainstem reflexes

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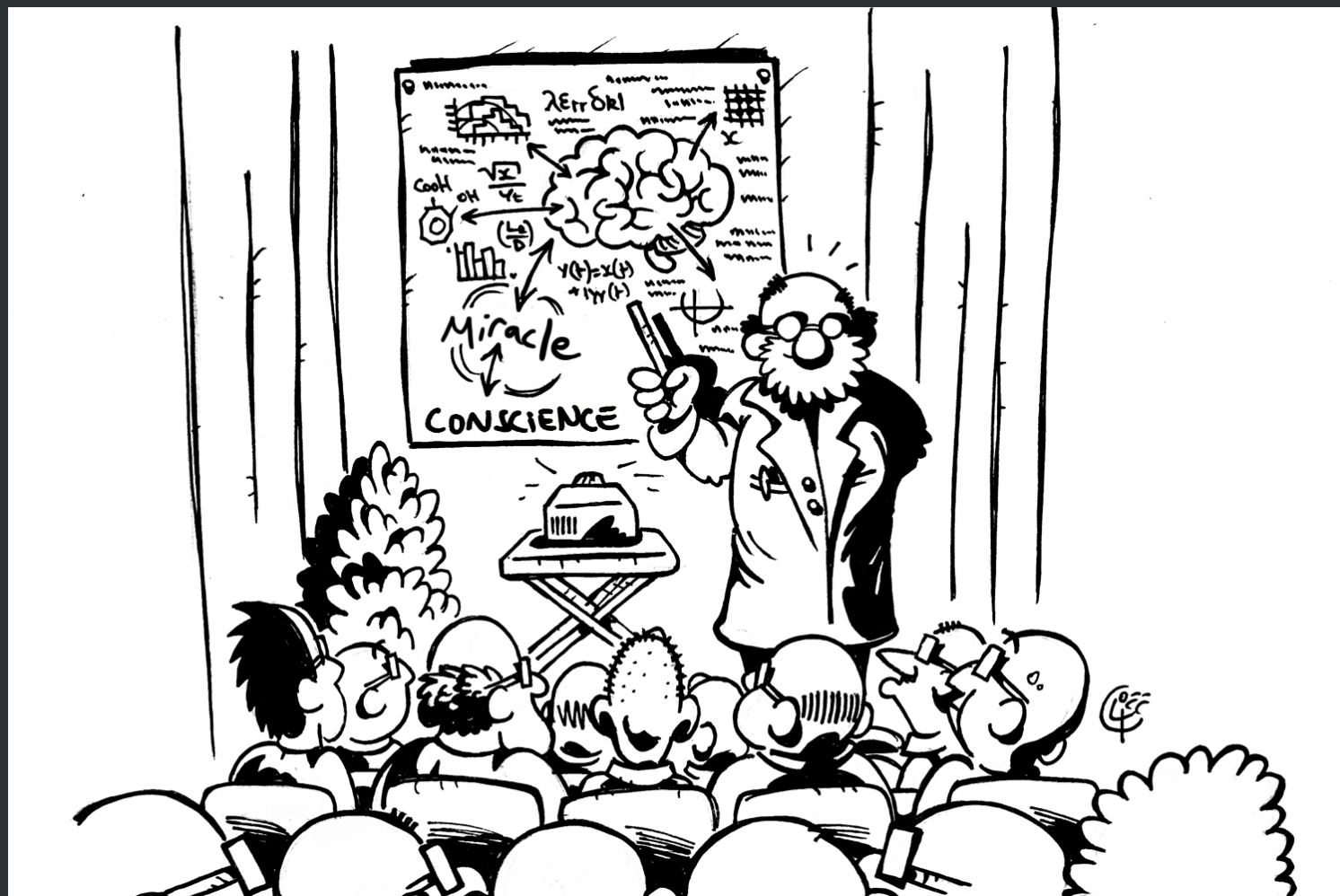
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# INTRODUCTION

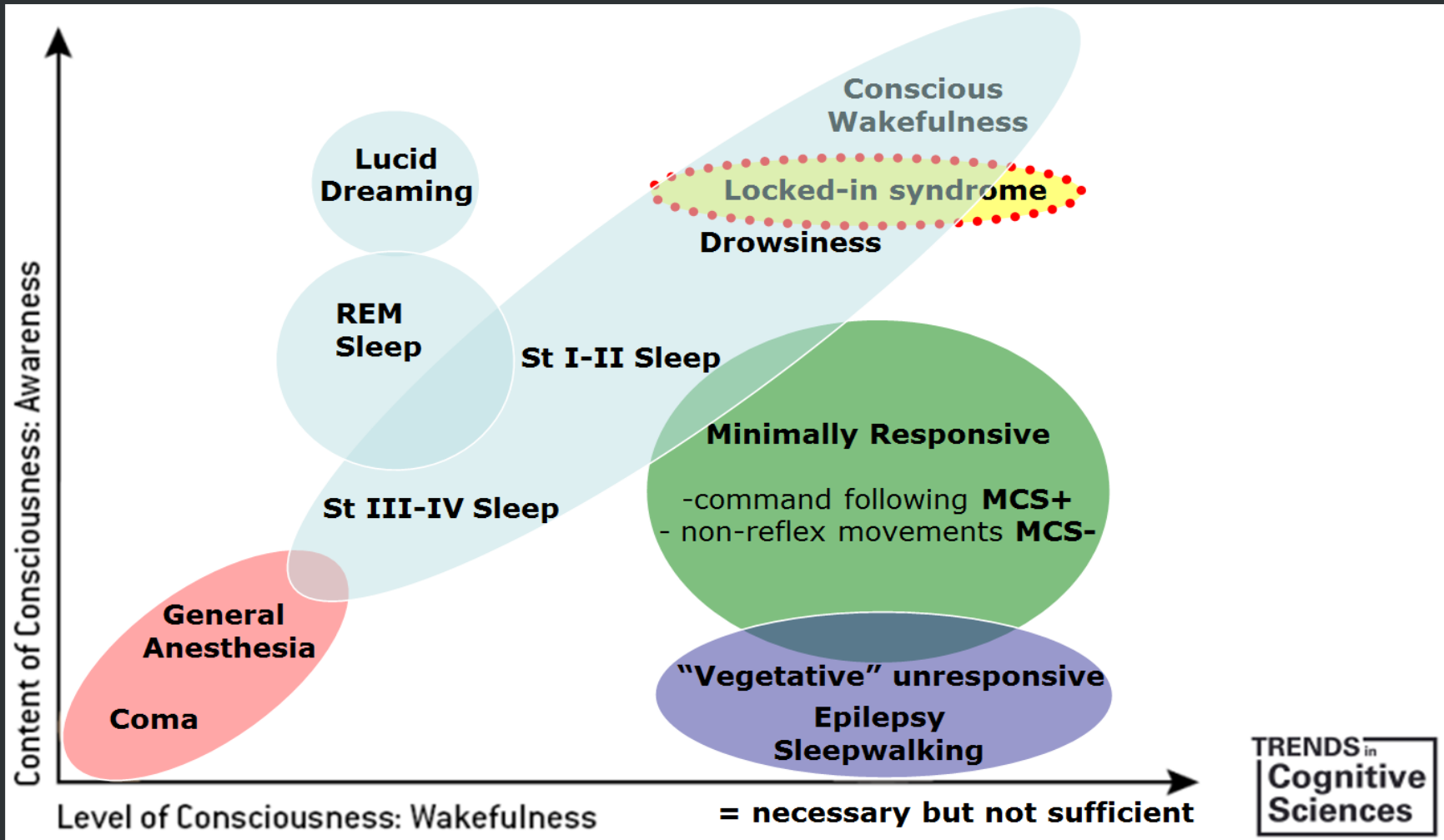
## Disorders of consciousness & behavioral scales



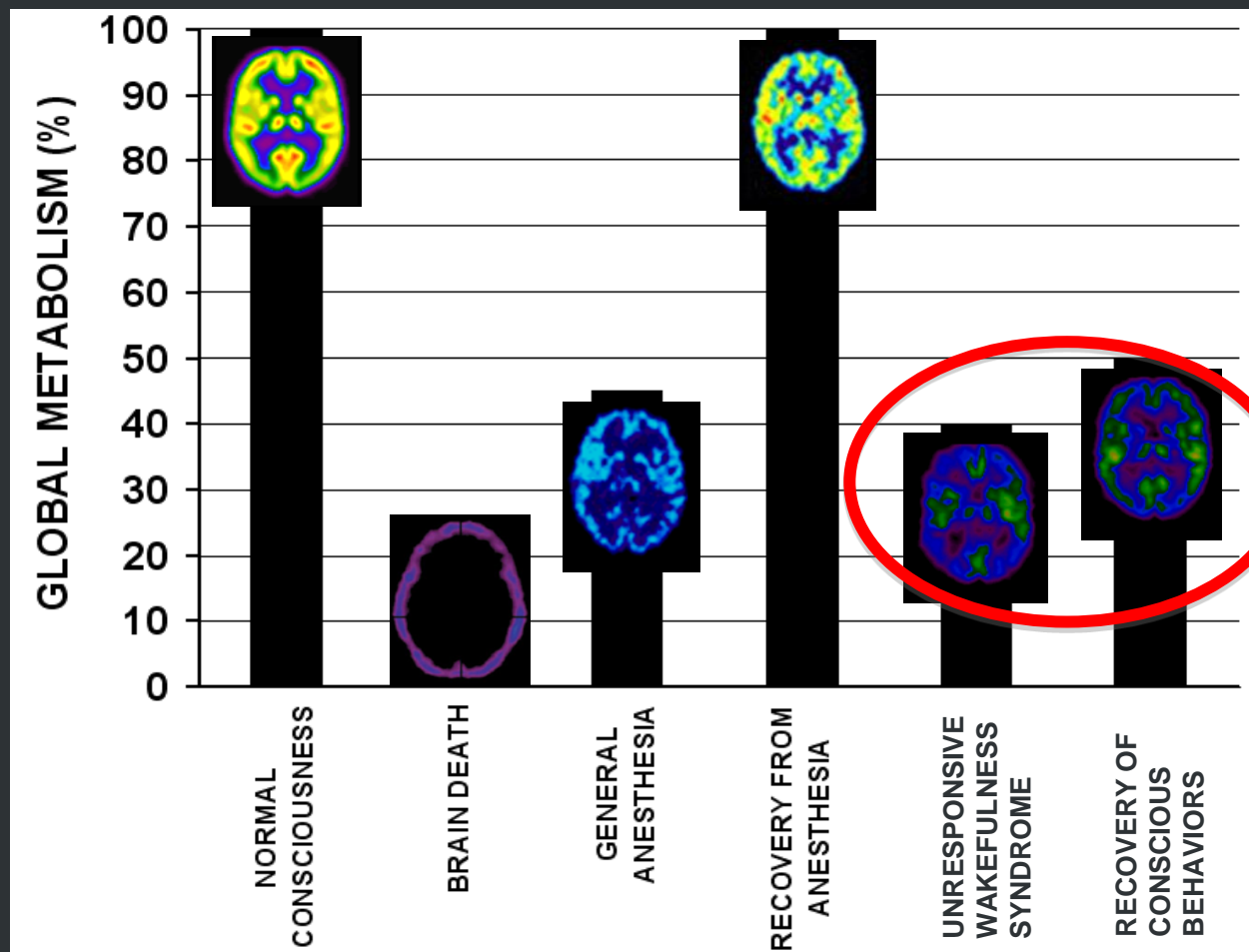
# WHAT IS CONSCIOUSNESS?



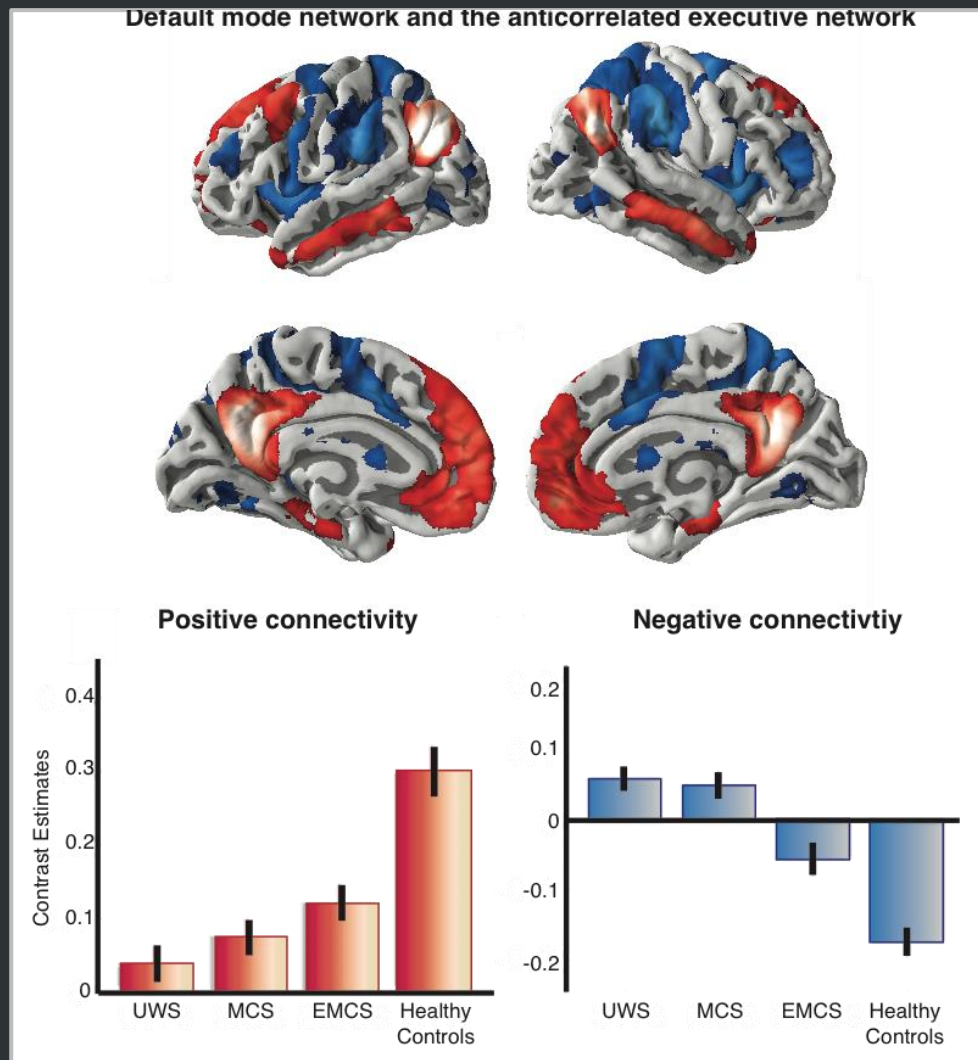
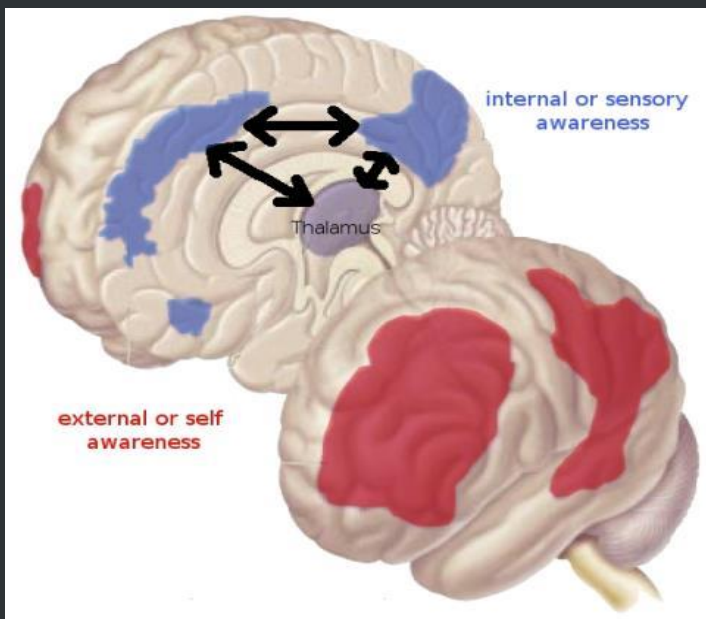
# Reducing consciousness to 2D



# Consciousness $\neq$ global brain function

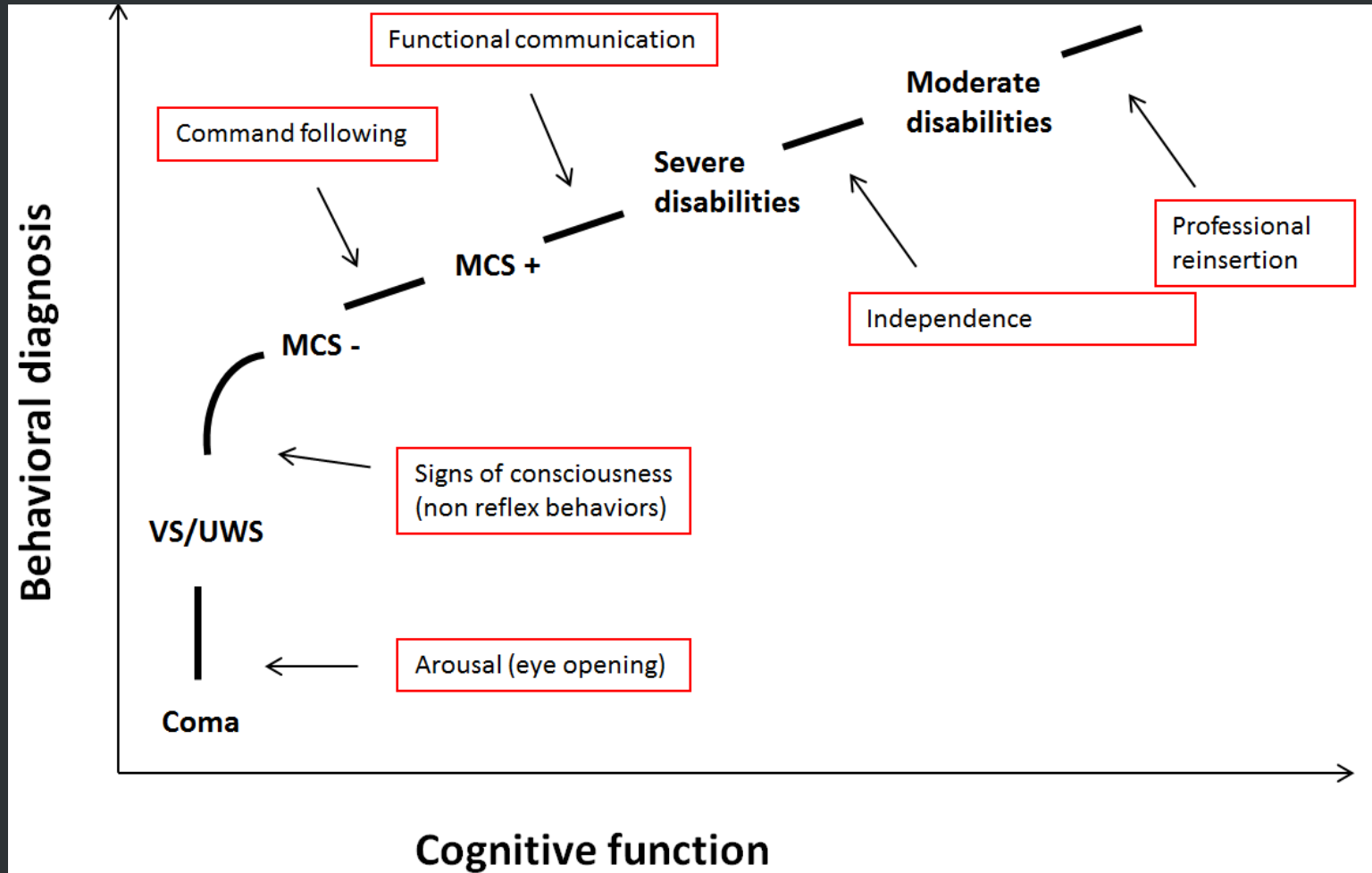


# Two awareness networks





# DISORDERS OF CONSCIOUSNESS



# Coma

- Eyes **always** closed
- Duration: > 1h
- Recovery from coma: few hours to 4 weeks



# Unresponsive wakefulness syndrome (UWS) (vegetative state)

Laureys et al. *BMC Medicine* 2010, **8**:68  
<http://www.biomedcentral.com/1741-7015/8/68>

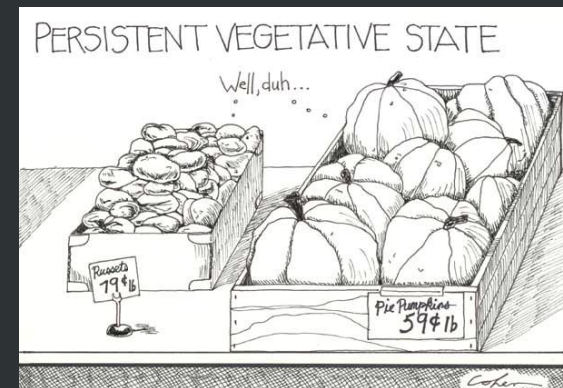
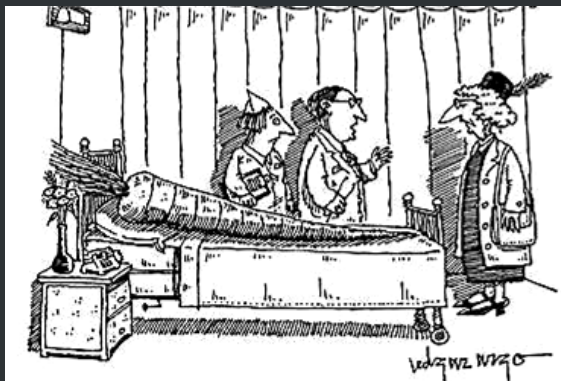


DEBATE

Open Access

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

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



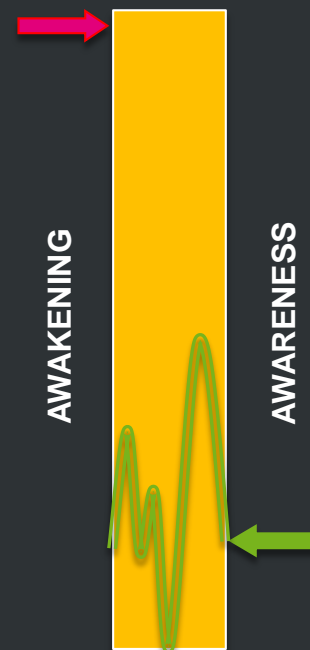
# Unresponsive wakefulness syndrome (UWS)

- Eye opening and closure
- Absence of purposeful behaviors
- Absence of language
- Preserved hypothalamic and brainstem autonomic functions



# Minimally conscious state (MCS)

- Eye opening
- Preserved sleep-wake cycles
- Clear signs of reproducible purposeful behaviors
- Emotionally contingent behaviors
- Challenge: fluctuation +++



# MCS - vs MCS +

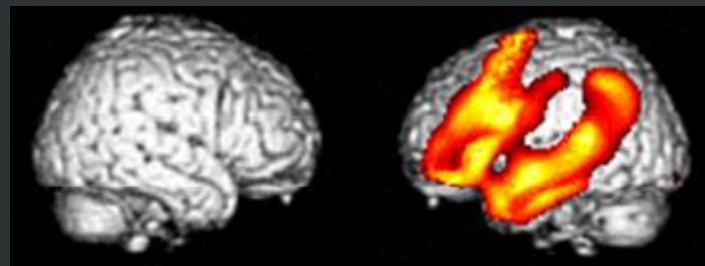
## MCS -

- Oriented (contextualized) behaviors
- Visual pursuit or fixation
- Orientation to noxious stimulation
- Reaching for objects
- Contingent behaviors (emotional)

## MCS +

- Following simple commands
- Intentional communication
- Intelligible verbalization

**MCS+ > MCS-**



# Emergence from minimally conscious state (EMCS)

- Functional communication  
AND/OR
- Functional object use
- The same item must be observed  
on 2 consecutive assessments



# Locked-in syndrome (LIS)

- Impaired motor function but preserved consciousness
- Preserved cognitive abilities
- Aphonia
- Anarthria
- Quadriplegia or quadriparesis
- Communication with vertical eyes movements and/or with blinking
- Partial LIS is possible







# BEHAVIORAL SCALES



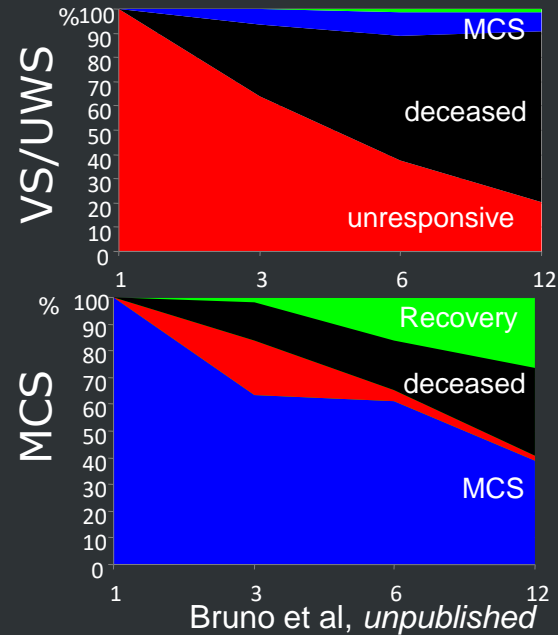
# Why is it important to assess consciousness?

- Misdiagnosis ~ 40%
- Standardized neurobehavioral assessment  
> clinical consensus!
- Prognostic, therapeutic and ethical implications
  - Prognosis/outcome depending on diagnosis, etiology, age and time since injury
  - MCS patients are more likely to perceive pain

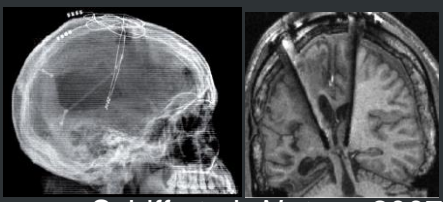
# Why is it important to assess consciousness?



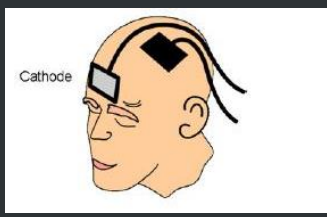
## Prognosis (non traumatic)



## Treatment

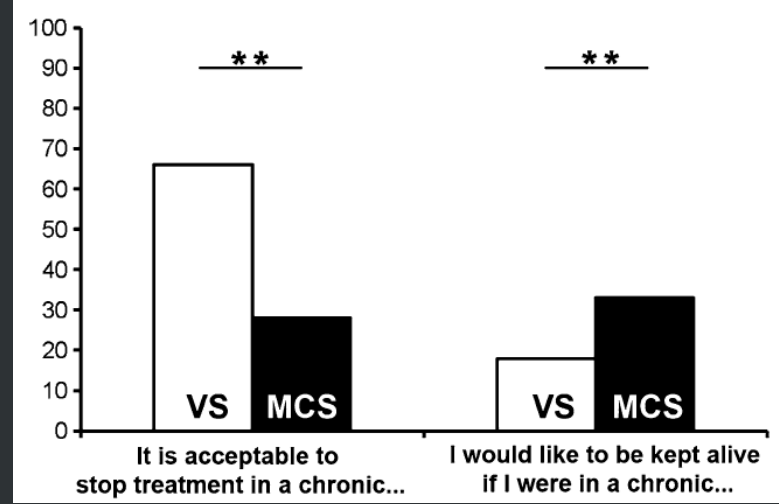


Schiff et al, *Nature*, 2007



Thibaut et al, *J Neurology* 2014

## Ethics





# Glasgow Coma Scale (GCS)

Especially useful in acute settings

3 subscales:

- E: Eyes opening (awakening)
- M: Motor (// consciousness)
- V: Verbal (// consciousness)

Total score = addition of subscales → /15



Short  
 Most well-known  
 Easy to administer  
 Most studied for its prognostic value  
 Allows recovery monitoring

Addition of subscales masks heterogeneity  
 Depends on the experience  
 Fluctuant inter-rater reliability  
 Scoring of patients with ocular trauma, tracheotomy or ventilatory support  
 No operational definition



# Glasgow Coma Scale (GCS)

Eye opening (E)			E
	Spontaneous=4		Spontaneous . . . . . 4
	Response to speech=3		To speech . . . . . 3
			To pain . . . . . 2
			Nil . . . . . 1
Motor response (M)			M
	Obeys=6		Obeys . . . . . 6
	Localizes=5		Localized . . . . . 5
	Withdraws=4		Withdraws . . . . . 4
			Abnormal flexion . . . . . 3
			Extensor response . . . . . 2
			Nil . . . . . 1
Verbal response (V)			V
	Oriented=5		Oriented . . . . . 5
	Confused conversation=4		Confused conversation . . . . . 4
	Inappropriate words=3		Inappropriate words . . . . . 3
	Incomprehensible sound=2		Incomprehensible sounds . . . . . 2
			Nil . . . . . 1
Coma score (E+M+V)=3 to 15			

Teasdale & Jennett, *The Lancet*, 1974; Laureys et al., *The Lancet Neurology*, 2014; Schnakers & Majerus, 2011 (Book: Coma et états de conscience altérée)

# Wessex Head Injury Matrix (WHIM)

6 components:

- Communication
- Attention
- Social behavior
- Concentration
- Visual awareness
- Cognition (memory & spatio-temporal orientation)



Hierarchical sequence  
Based on longitudinal  
observation of recovery in  
88 coma patients  
Precise operational  
definition for each item  
Score= most advanced  
behavior  
Useful to assess MCS  
behaviors

Unproven reliability  
Diagnostic sensitivity < other  
standardized scales



# Wessex Head Injury Matrix (WHIM)

Nom: \_\_\_\_\_  
 Date de naissance: \_\_\_\_\_  
 Hôpital: \_\_\_\_\_  
 Unité: \_\_\_\_\_

## Wessex Head Injury Matrix (62 Items)

Adaptation française avec l'autorisation de A. Shiel, auteur, en collaboration par:  
 S. Majerus, & M. Van der Linden, Service de Neuropsychologie, Université de Liège (Belgique);  
 A. Fontaine, A.C. Tissier, N. Marlier, & P. Azouvi, Hôpital R. Poincaré, Garches (France).

Commencez à l'item 1. Mettez une barre pour tout item observé et une croix pour tout comportement non-observé. Arrêtez la cotation après 10 croix consécutives. Le rang du comportement le plus avancé constitue le score.

		DATE											
Score WHIM												Rang du comportement le plus avancé	
No	COMPORTEMENTS OBSERVES											DEFINITIONS OPERATIONNELLES	
1	Ouverture brève des yeux											Moins de 30 secondes	
2	Ouverture prolongée des yeux											Plus de 30 secondes	
3	Les yeux sont ouverts et bougent mais ne se fixent pas sur une personne ou un objet											Les yeux bougent de manière aléatoire, sans signe de poursuite et ils ne s'arrêtent pas sur un objet ou une personne.	
4	Attention momentanément captée par un stimulus dominant											Momentanément = 2 secondes ou plus; stimulus dominant = bruyant/grand/vivement coloré/douloureux entraînant un changement identifiable du comportement bien que momentané, p.ex. agité > calme, yeux fermés > ouverts, immobile > mouvements, etc.	
5	Regarde brièvement une personne											Le regard se déplace sans but à travers la chambre...lorsqu' un objet ou une personne est remarqué, les yeux se fixent sur celui-ci. Brièvement = momentanément- Impression qu'il regarde quelqu'un ou quelque chose.	
6	Vocalisation volontaire, pour exprimer ses sensations											Gémissements comme pour exprimer un malaise, soit spontanément soit lors de manipulations passives des membres contractés, d'injections ou de prises de sang.	

# Full Outline of Unresponsiveness scale (FOUR)

4 subscales:

- Motor responses
- Ocular responses
- Brainstem reflexes
- Respiration

Total score /16




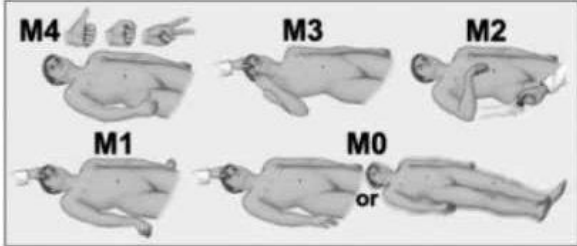
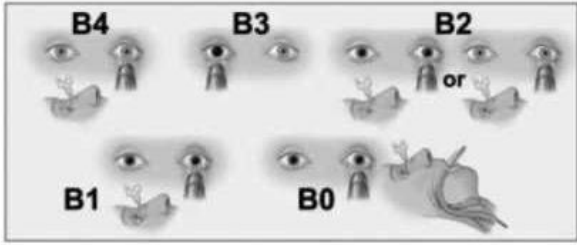
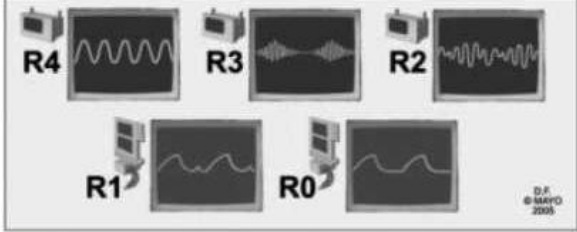
Good inter-rater reliability  
 No assessment of verbal functions  
 Same weight for each subscale  
 Diagnosis of brain death  
 Follow recovery of autonomous functions  
 Visual pursuit  
 Neurological progression of UWS patients  
 Assessment of cognitive functions  
 Detection of LIS  
 Fast administration

Not suited for  
rehabilitation  
setting





# Full Outline of Unresponsiveness scale (FOUR)

 <p><b>E4</b> <b>E3</b></p> <p><b>E2</b> <b>E1</b> <b>E0</b></p> <p>Look up, look down, blink twice</p> <p>Open your eyes</p>	<p><b>Eye response</b></p> <p>4 = Eyelids open or opened, tracking or blinking to command</p> <p>3 = Eyelids open but not tracking</p> <p>2 = Eyelids closed but open to loud voice</p> <p>1 = Eyelids closed but open to pain</p> <p>0 = Eyelids remain closed with pain</p>
 <p><b>M4</b> <b>M3</b> <b>M2</b></p> <p><b>M1</b> <b>M0</b></p> <p>or</p>	<p><b>Motor response</b></p> <p>4 = Thumbs-up, fist or peace sign</p> <p>3 = Localising to pain</p> <p>2 = Flexion response to pain</p> <p>1 = Extension response to pain</p> <p>0 = No response to pain, or generalised myoclonus status</p>
 <p><b>B4</b> <b>B3</b> <b>B2</b></p> <p><b>B1</b> <b>B0</b></p> <p>or</p>	<p><b>Brainstem reflexes</b></p> <p>4 = Pupil and corneal reflexes present</p> <p>3 = One pupil wide and fixed</p> <p>2 = Pupil or corneal reflexes absent</p> <p>1 = Pupil and corneal reflexes absent</p> <p>0 = Absent pupil, corneal and cough reflex</p>
 <p><b>R4</b> <b>R3</b> <b>R2</b></p> <p><b>R1</b> <b>R0</b></p> <p>D.F. © Mayo 2005</p>	<p><b>Respiration</b></p> <p>4 = Not intubated, regular breathing pattern</p> <p>3 = Not intubated, Cheyne-Stokes breathing pattern</p> <p>2 = Not intubated, irregular breathing</p> <p>1 = Breathes above ventilator rate</p> <p>0 = Breathes at ventilator rate or apnoea</p>

# Coma Recovery Scale – Revised (CRS-R)

23 items assessing:

- Auditory perception
- Visual perception
- Motor abilities
- Oro-motor abilities
- Communication
- Arousal

+ Brainstem reflexes and contingent behaviors



Standardized & validated

Most sensitive to identify MCS behaviors (2002)

Precise operational definition for each item

Hierarchisation of items

Observation of spontaneous movements

Complex functions (communication/functional use of objects)

Diagnosis based on quality of observed behaviors

Best to use but:

Total score does not permit to identify diagnosis (subscales)

Long to administer



# Coma Recovery Scale – Revised (CRS-R)

<b>JFK COMA RECOVERY SCALE - REVISED</b> ©2004 Record Form									
<b>Patient:</b>	<b>Date:</b>								
<b>AUDITORY FUNCTION SCALE</b>									
4 - Consistent Movement to Command *									
3 - Reproducible Movement to Command *									
2 - Localization to Sound									
1 - Auditory Startle									
0 - None									
<b>VISUAL FUNCTION SCALE</b>									
5 - Object Recognition *									
4 - Object Localization: Reaching *									
3 - Visual Pursuit *									
2 - Fixation *									
1 - Visual Startle									
0 - None									
<b>MOTOR FUNCTION SCALE</b>									
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									
		<b>OROMOTOR/VERBAL FUNCTION SCALE</b>							
		3 - Intelligible Verbalization *							
		2 - Vocalization/Oral Movement							
		1 - Oral Reflexive Movement							
		0 - None							
		<b>COMMUNICATION SCALE</b>							
		2 - Functional: Accurate †							
		1 - Non-Functional: Intentional *							
		0 - None							
		<b>AROUSAL SCALE</b>							
		3 - Attention							
		2 - Eye Opening w/o Stimulation							
		1 - Eye Opening with Stimulation							
		0 - Unarousable							
		<b>TOTAL SCORE</b>							

# Why the CRS-R?

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- Guidelines of administration & scoring procedures
- Excellent content validity & test-retest reliability
- Standardized administration and scoring
- Most sensitive scale to detect MCS

N.B.

Identification of possible confounding factors (deafness, aphasia, blindness) when improbable scoring occurs

When using only one CRS-R assessment ~ 34% chance of false negatives  
→ Perform **at least 5 assessments!**

<http://www.comascience.org/>

# But...

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- Difficult to use and to be repeated in daily care
- Requirement of concentration +++
  
- Development of short CRS-R = the SECONDS (Simplified Evaluation of CONsciousness Disorders)
  - Use of most frequent signs of consciousness:
    - Observation
    - Command-following
    - Communication
    - Visual pursuit
    - Visual fixation
    - Localization to pain
    - Arousal
    - Oriented behaviors

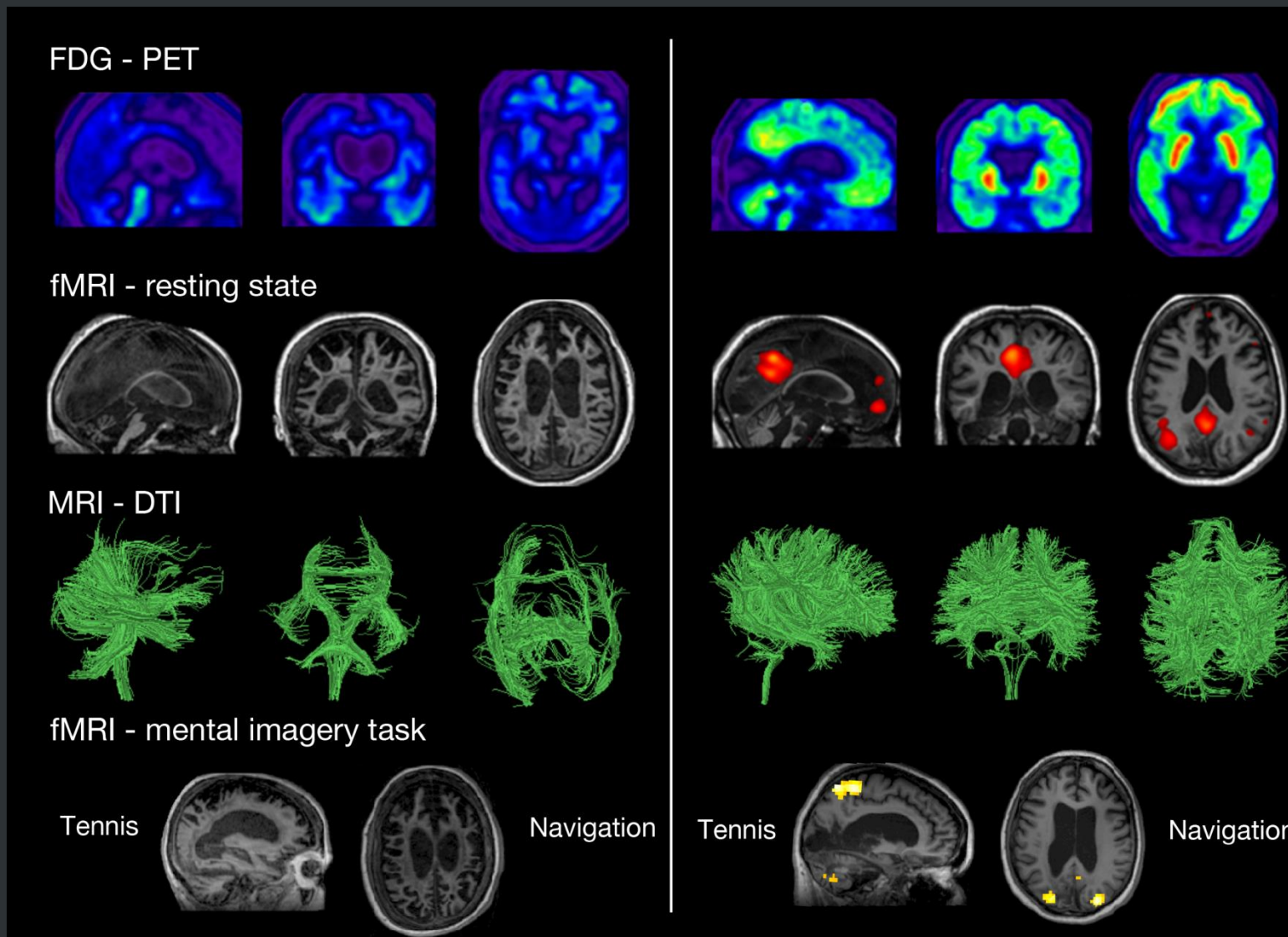


- Difficult to use and to be
- Requirement of concen
- Development of short C
- Evaluation of CONsciousness
  - Use of most frequent signs
    - Observation
    - Command-following
    - Communication
    - Visual pursuit
    - Visual fixation
    - Localization to pain
    - Arousal
    - Oriented behaviors

**Simplified Evaluation of CONsciousness Disorders (SECONDS)**

ID patient	Examineur : <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C		
Date	Evaluation n°		
Heure début	Heure fin		
<input type="checkbox"/> Neuro <input type="checkbox"/> USI <input type="checkbox"/> Autre:			
Diag	Score	Item	Remarques
Coma	0	Pas d'éveil	
UWS/Vs	1	Eveil	Spontanément / auditif / tactile / douleur n= 0-25% - 25-50% - 50-75% - 75-100%
	2	Localisation à la douleur	G : /1                      Anticipation? /2 D: /1
	3	Fixation visuelle	Q sup G: /1    Q sup D: /1 Q inf G: /1    Q inf D: /1
MCS-	4	Poursuite visuelle	H: /2                      V: /2
	5	Comportements orientés	Observés :                      Nb :
	6	Réponse à la commande	Comm. : écrit - oral                      Scores : 1. /3 2. /3 3. /3
MCS+	7	Ebauche de communication	Code :                      Questions/réponses: OUI= NON=
EMCS	8	Communication fiable	
Score total :		Diagnostic :	Index add. : /100
Remarques:			

# Consciousness $\neq$ responsiveness





Any questions?

THANK YOU!



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de Liège

