

昏迷

人的清醒意識及各種意識障礙

意識的兩個元素

Consciousness: 2 components

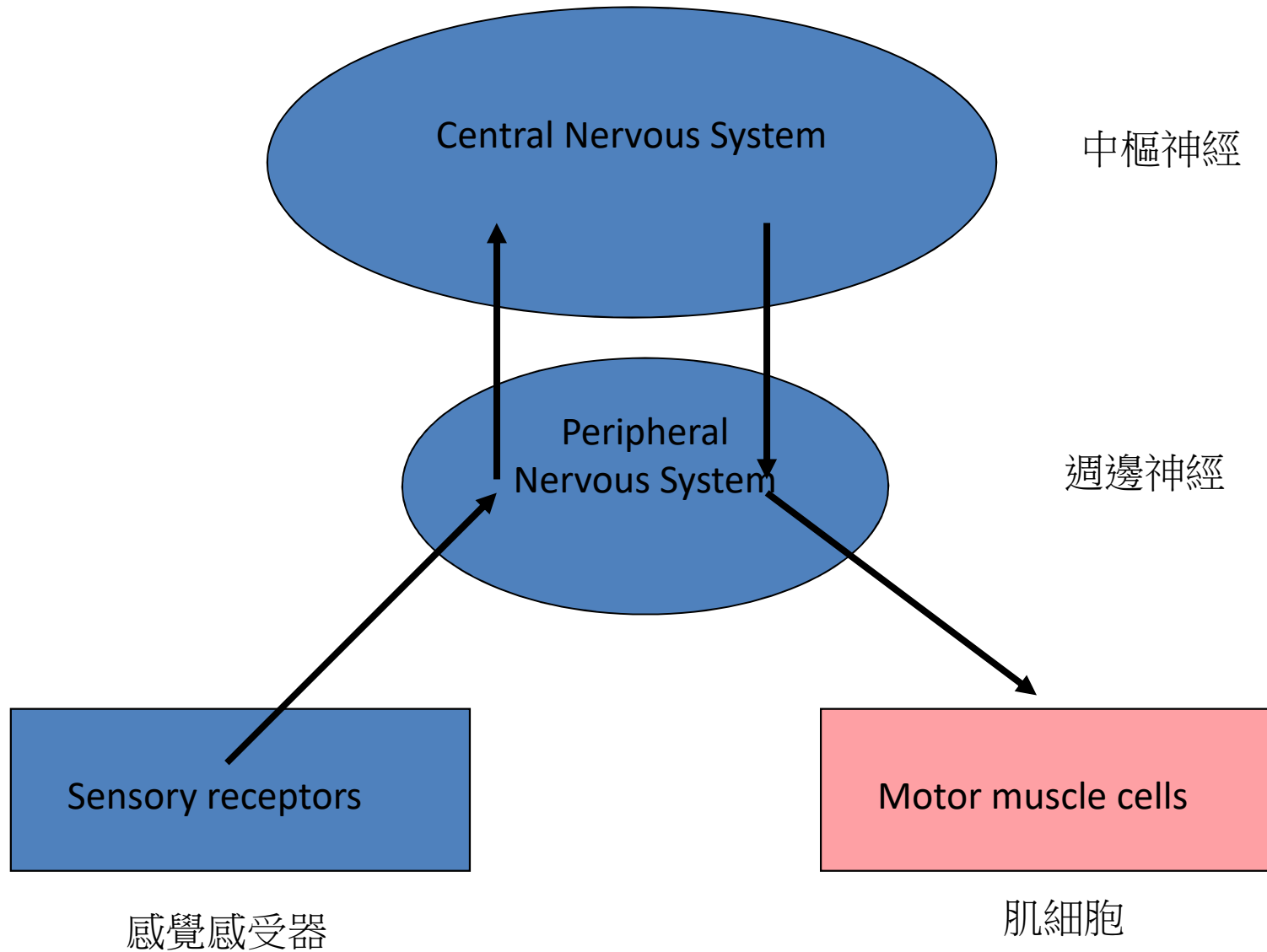
- 覺醒 Wakefulness (喚醒 arousal):
意識的程度 level of consciousness
- 覺察 Awareness: 意識的內容
content of consciousness

意識

Consciousness

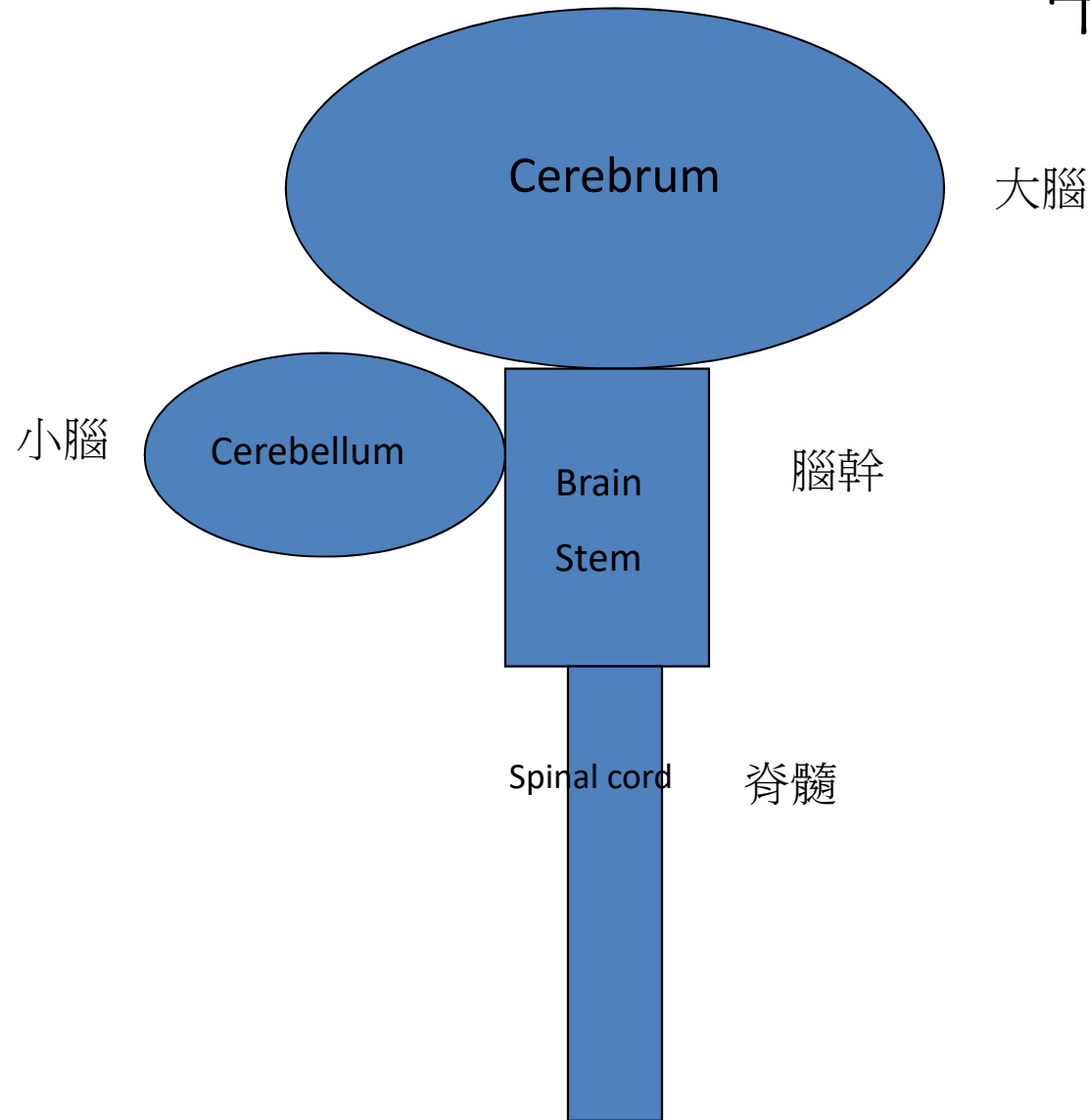
- 覺醒 Wakefulness: 網狀結構 reticular formation
- 覺察 Awareness:
 - 丘腦和大腦皮層聯系整合 integration by thalamus-cortex connections
 - 大腦皮層各區域的聯系整合 integration by cortex-cortex connections

The Nervous System 神經系統



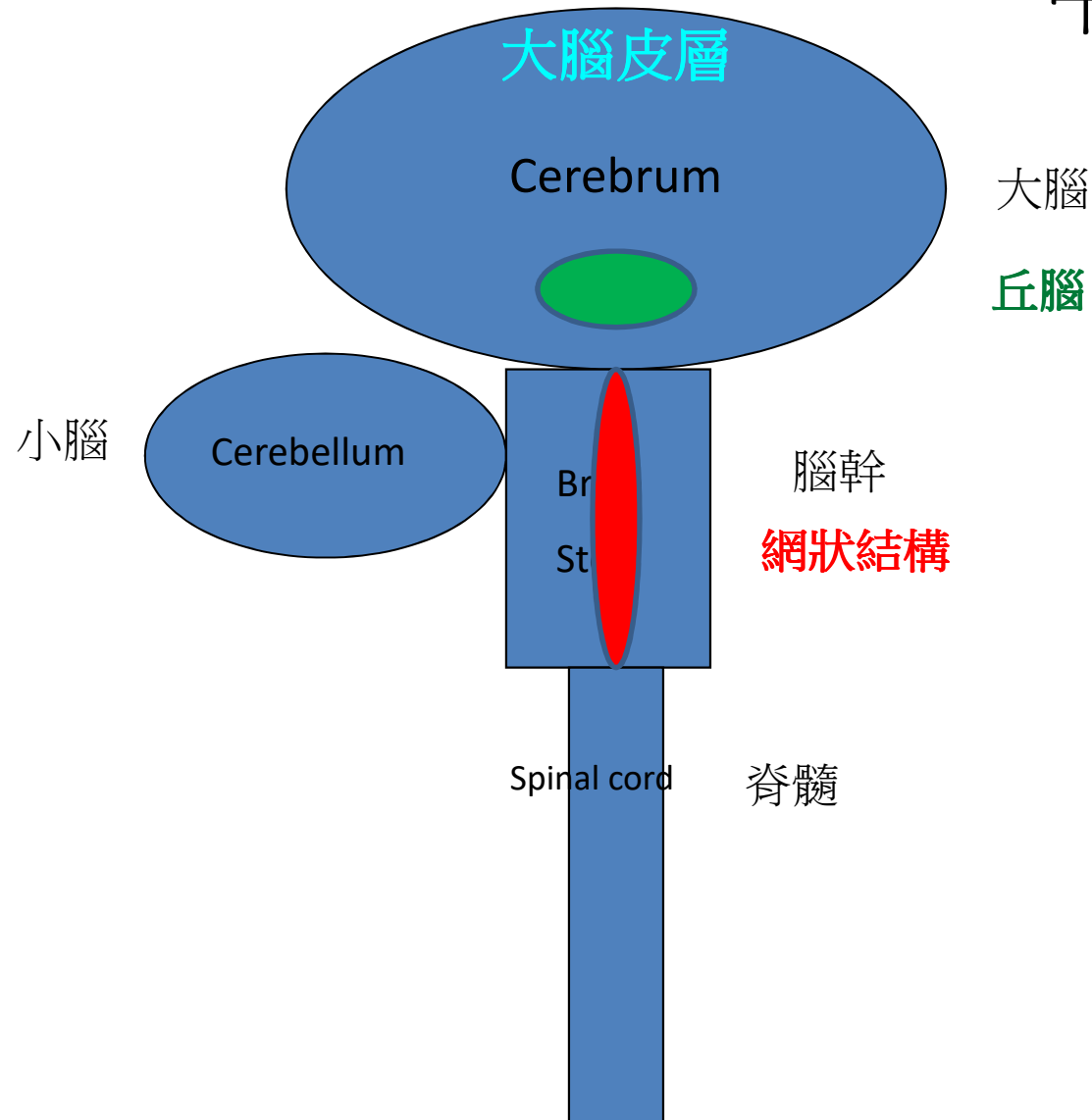
The Central Nervous System

中樞神經



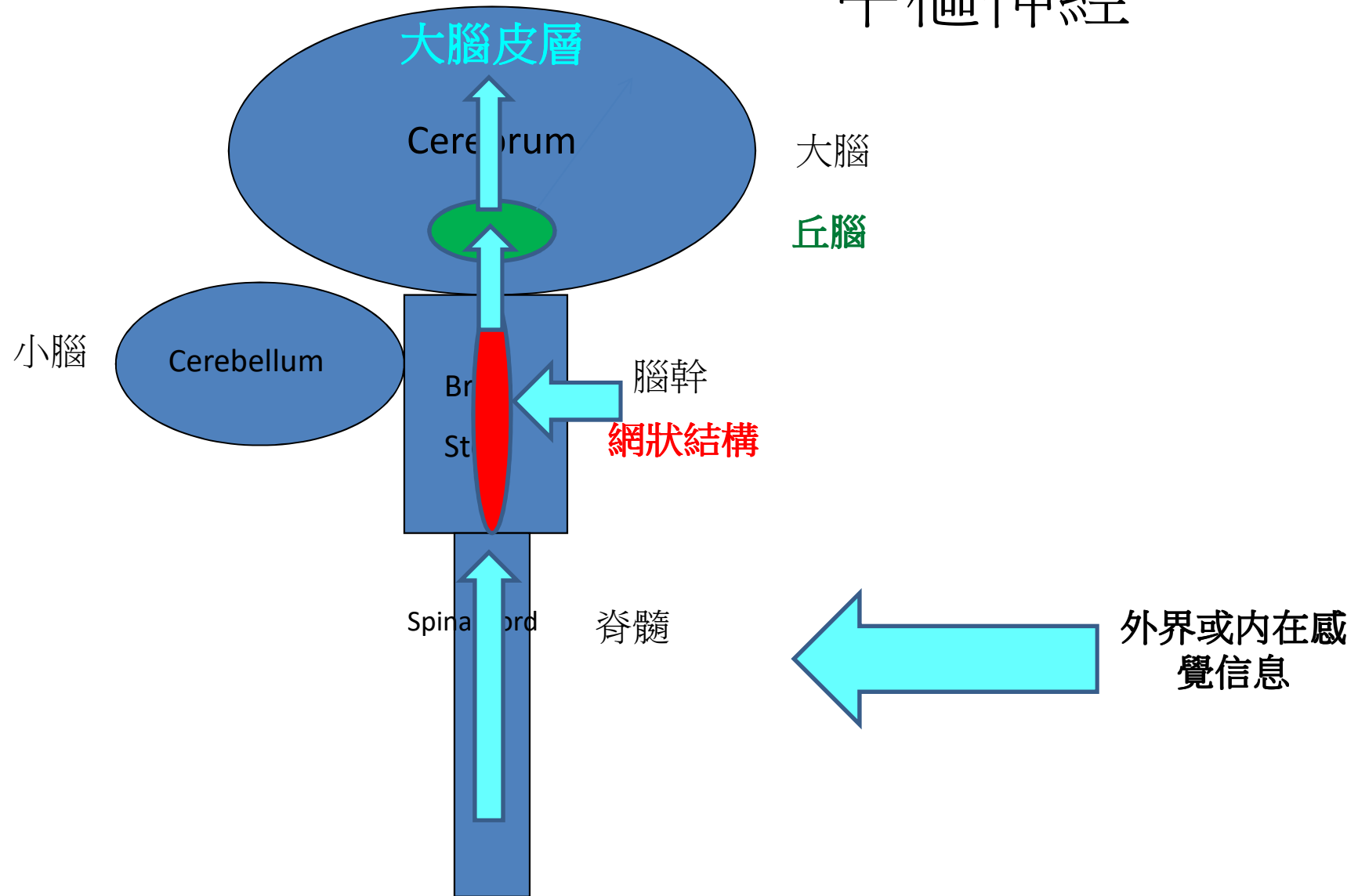
The Central Nervous System

中樞神經



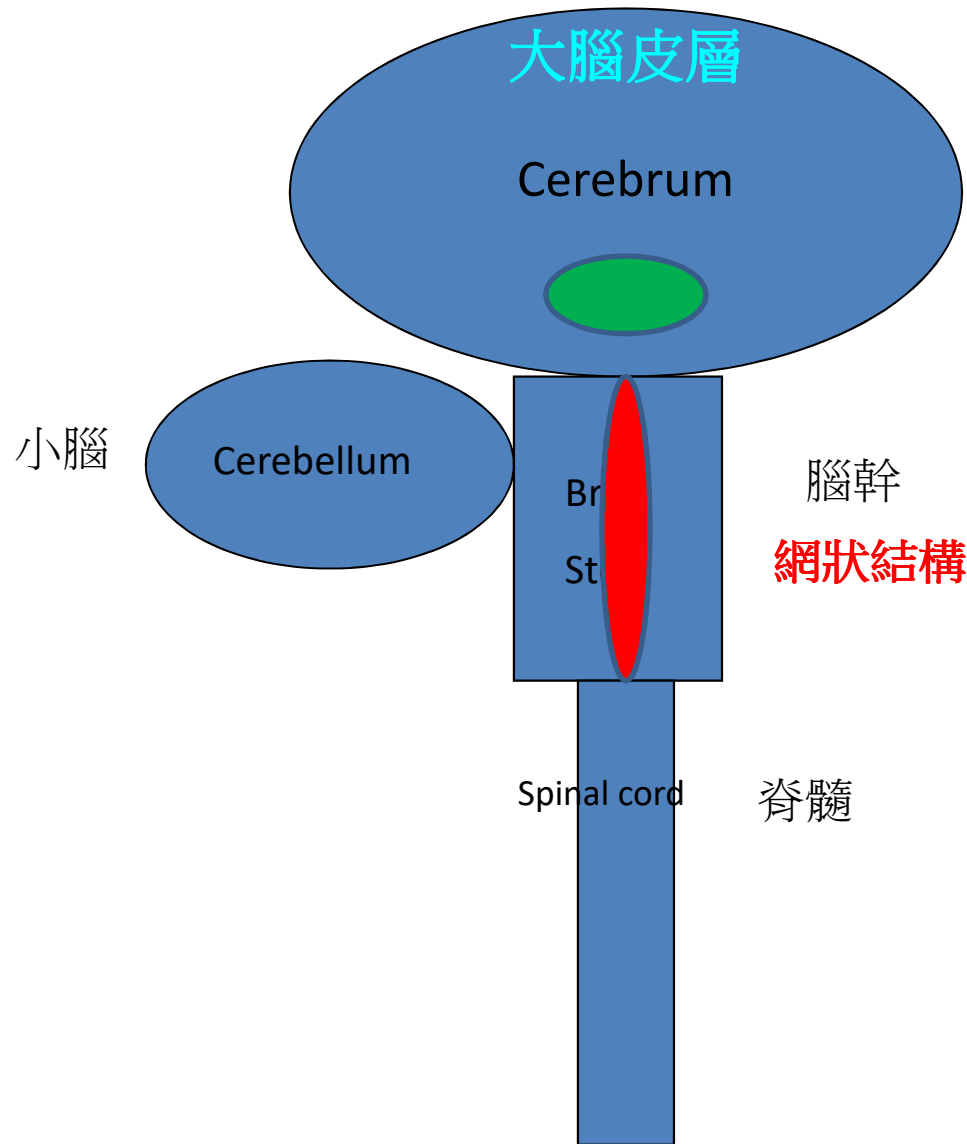
The Central Nervous System

中樞神經



The Central Nervous System

中樞神經



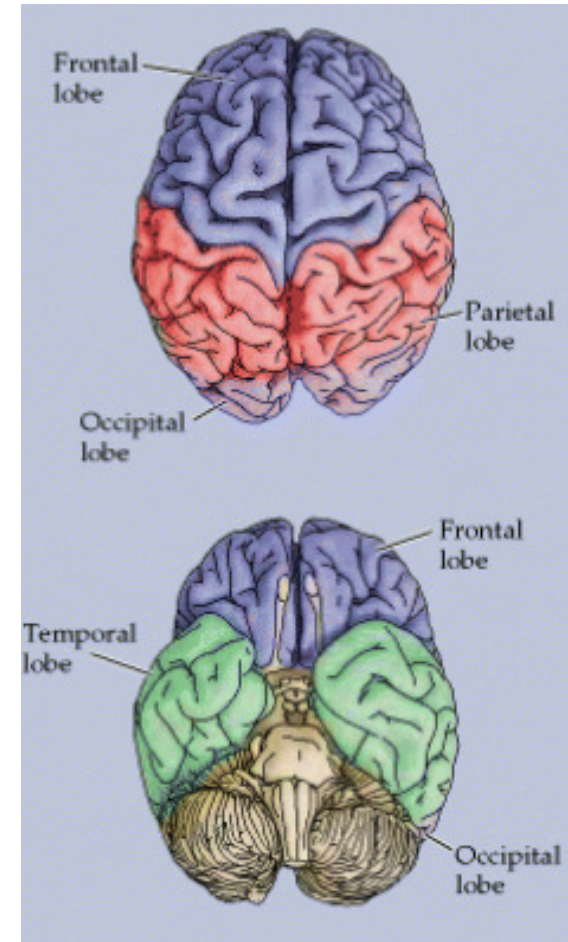
大腦

丘腦

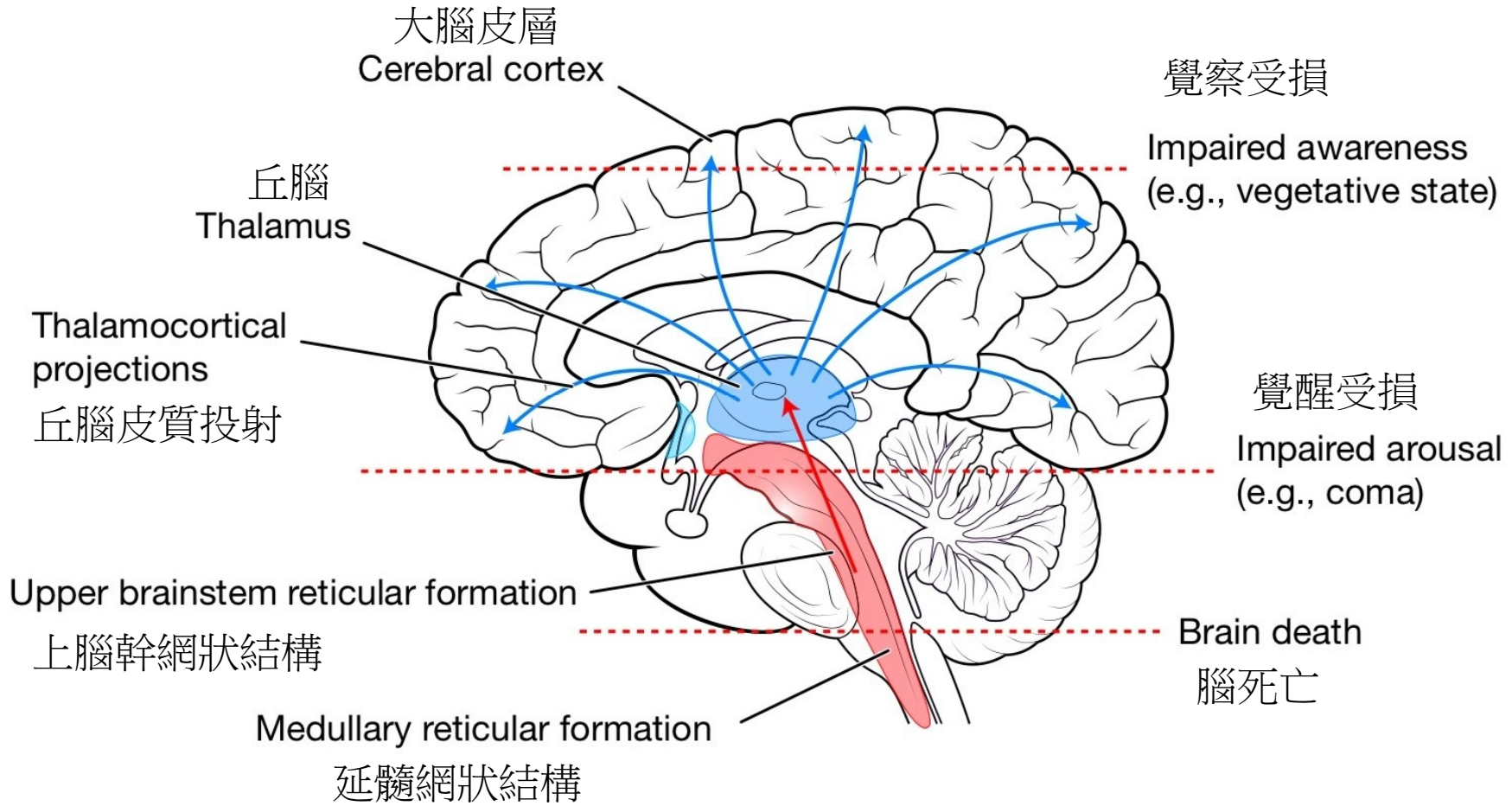
腦幹

網狀結構

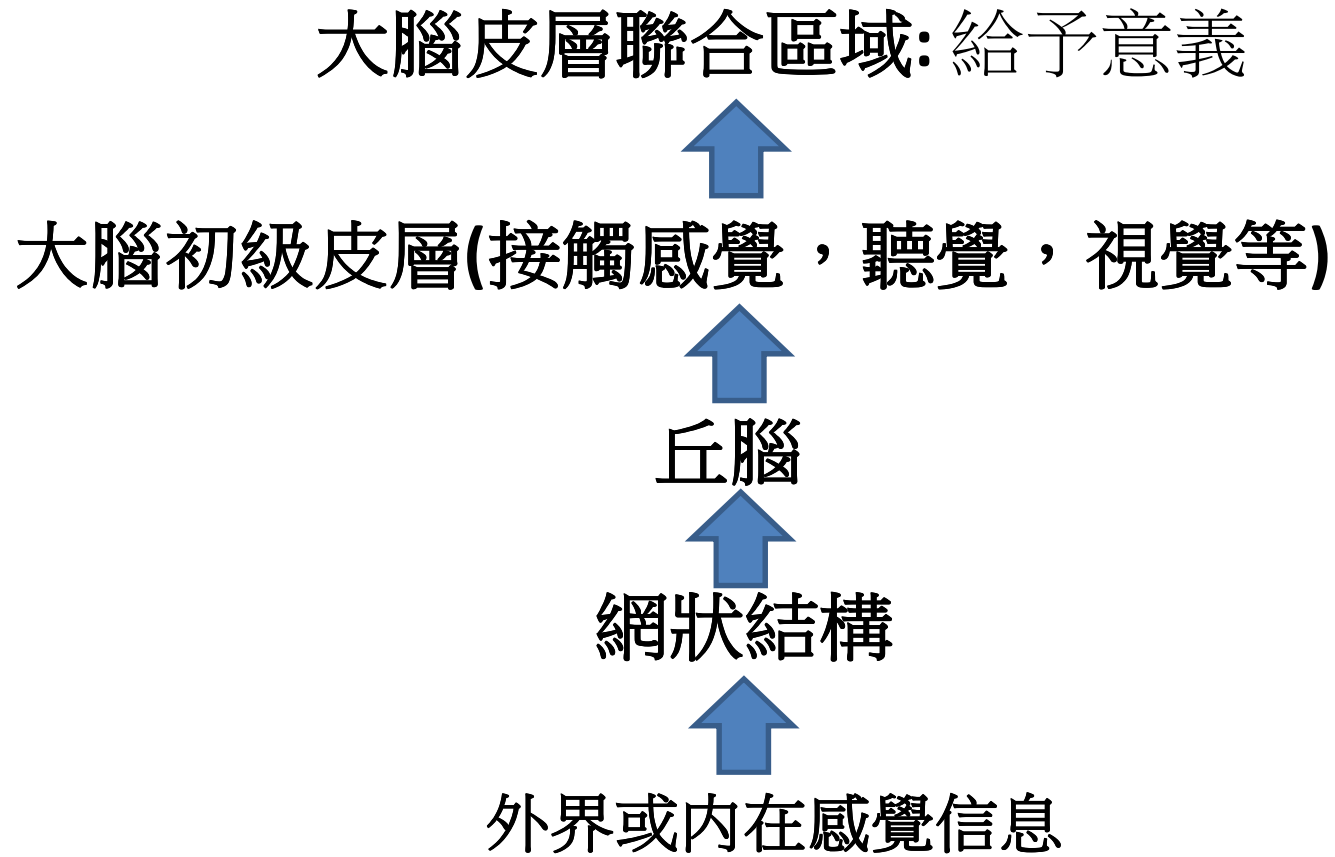
脊髓



意識的腦神經運作



意識的腦神經運作



昏迷與充分意識之間

- Coma 昏迷
- Unresponsive wakefulness syndrome 無反應性覺醒綜合症
- Persistent vegetative state 持續植物狀態
- Minimally conscious state 最小意識狀態



昏迷



無反應性覺醒
綜合症

持續植物狀態

最小意識狀態



昏迷



無反應性覺醒
綜合症

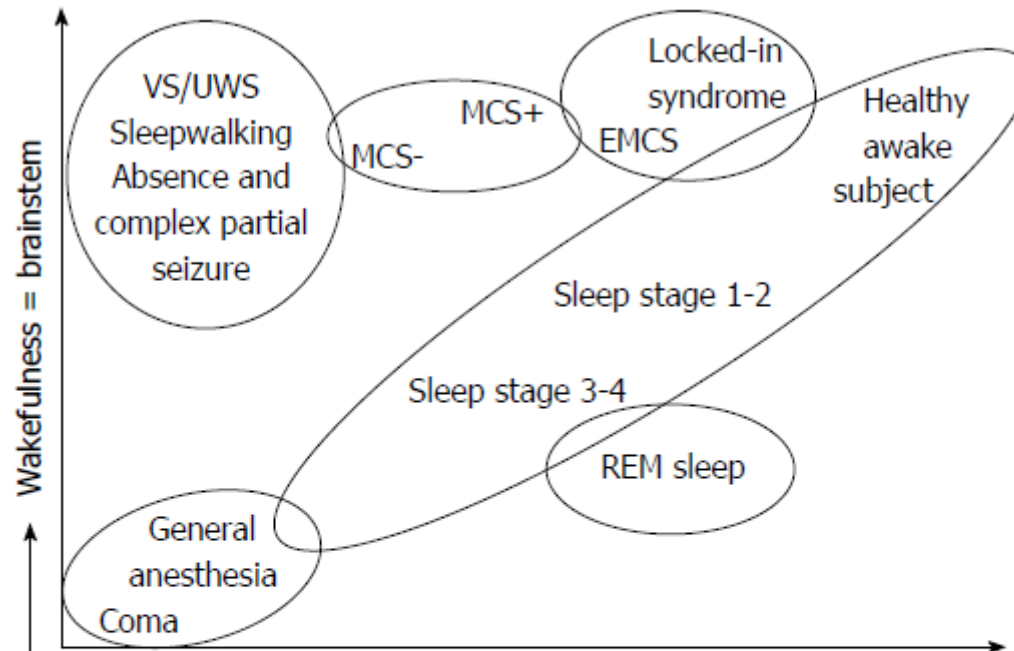
持續植物狀態



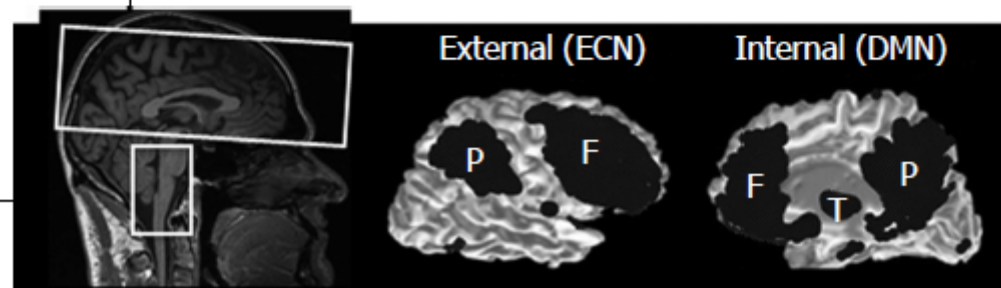
最小意識狀態

覺醒 Wakefulness 和 覺察 Awareness

覺醒 = 腦幹



覺察 = “大腦皮層”連接“丘腦”網絡

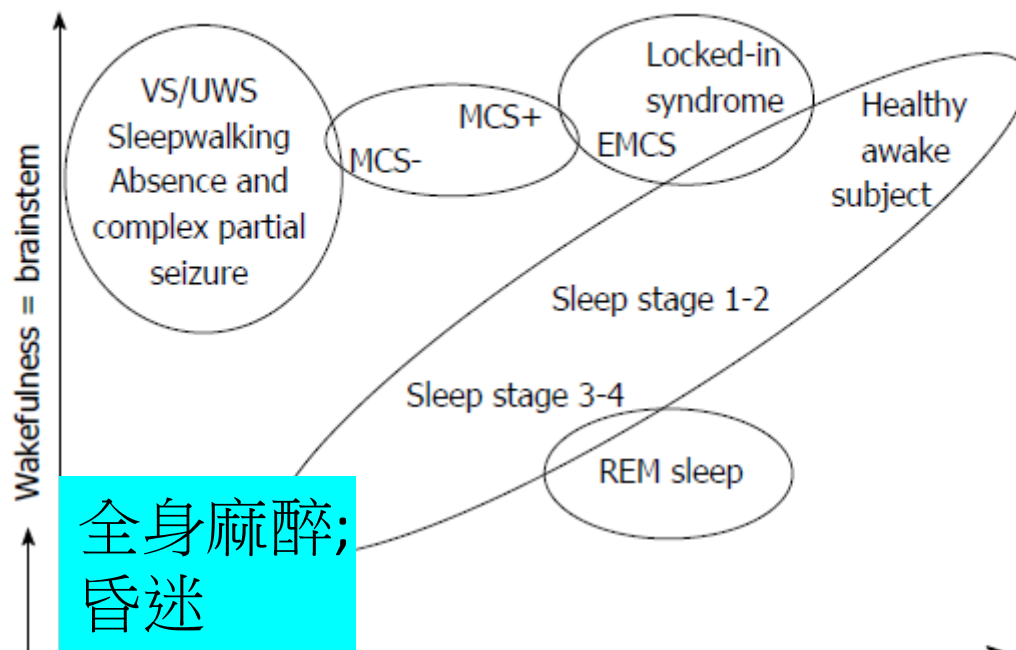


體外覺察

體內覺察

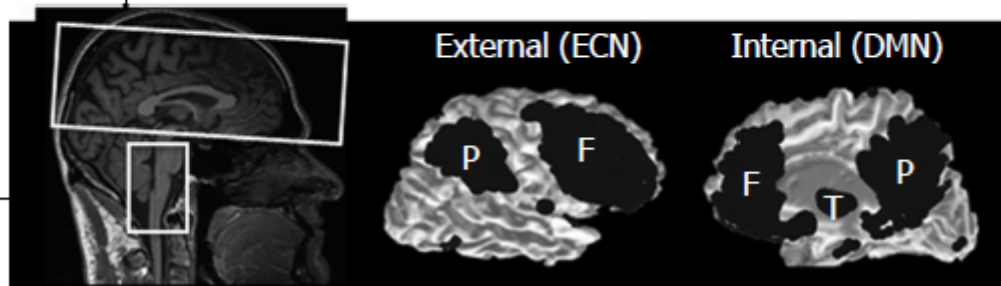
覺醒 Wakefulness 和 覺察 Awareness

覺醒 = 腦幹



全身麻醉;
昏迷

Awareness = cortico-thalamo network 覺察 = “大腦皮層”連接“丘腦”網絡

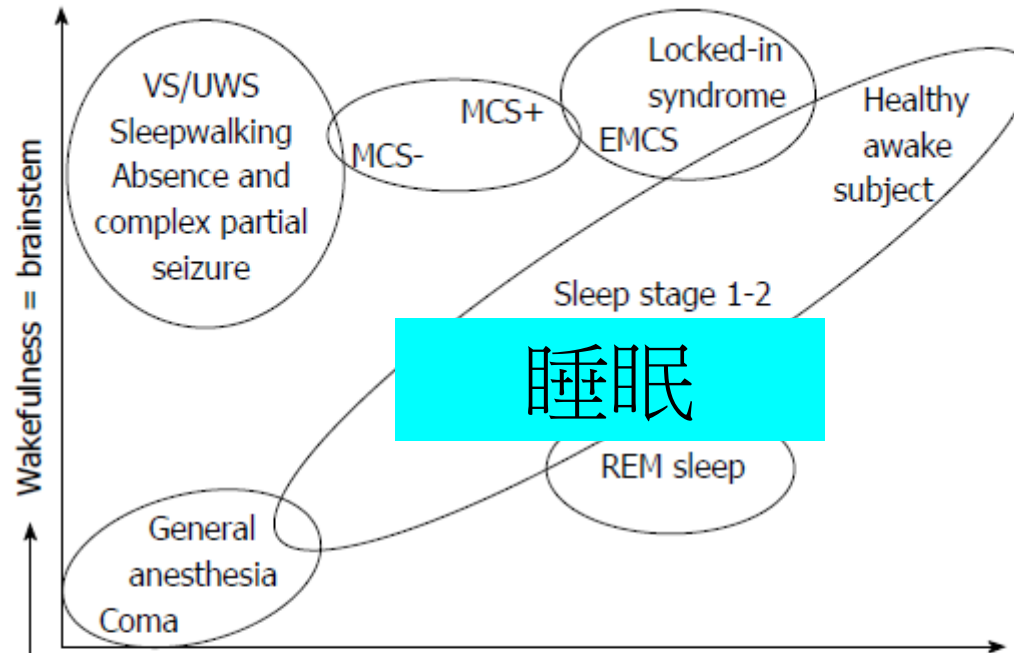


體外覺察

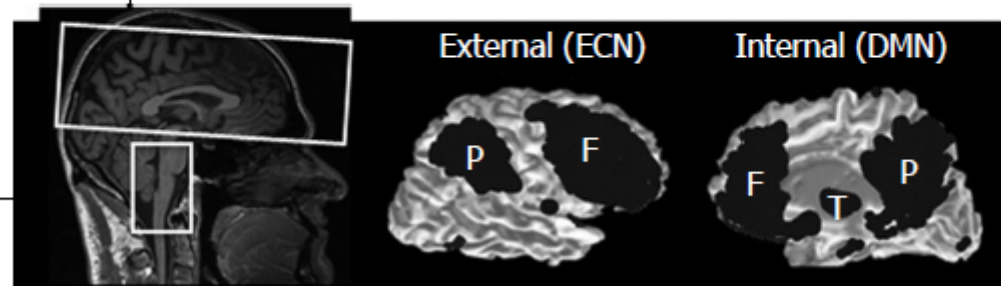
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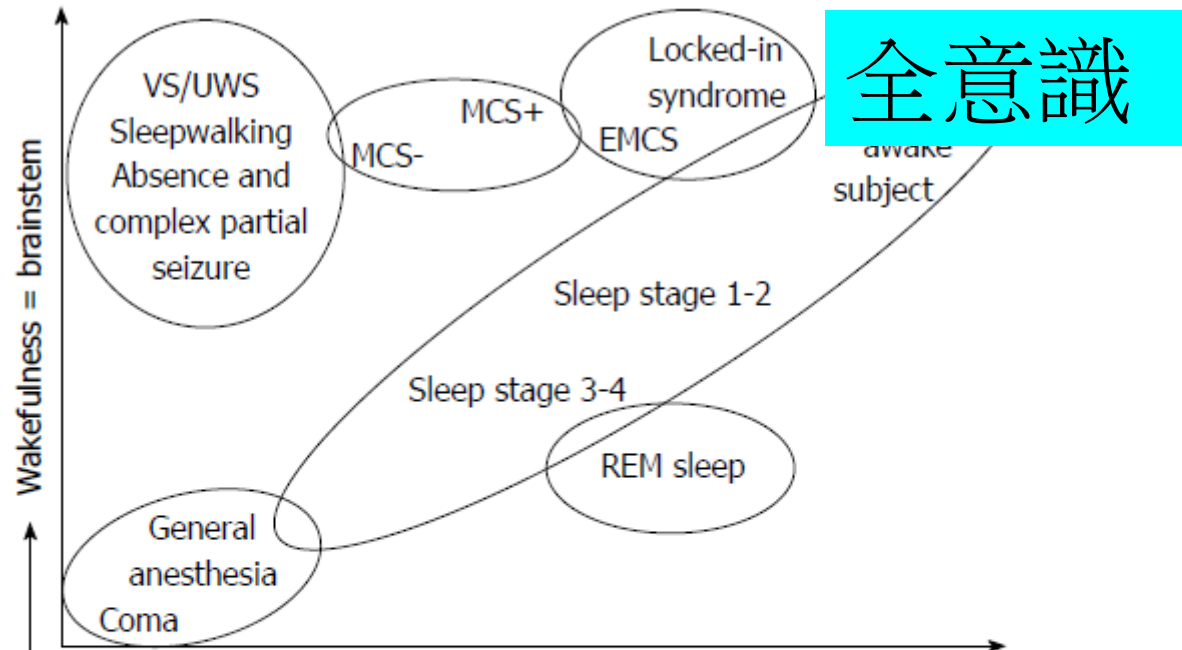


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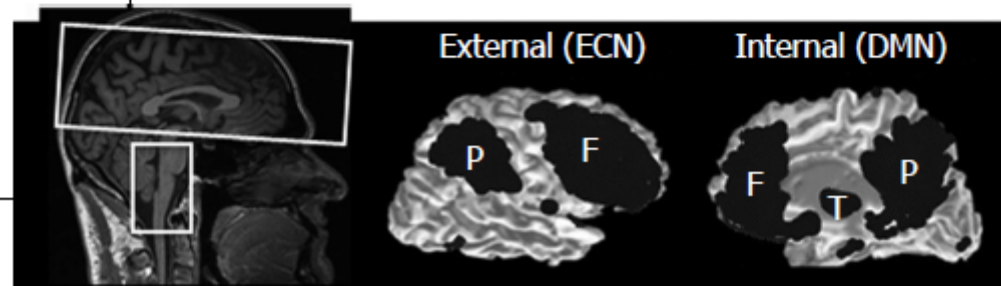
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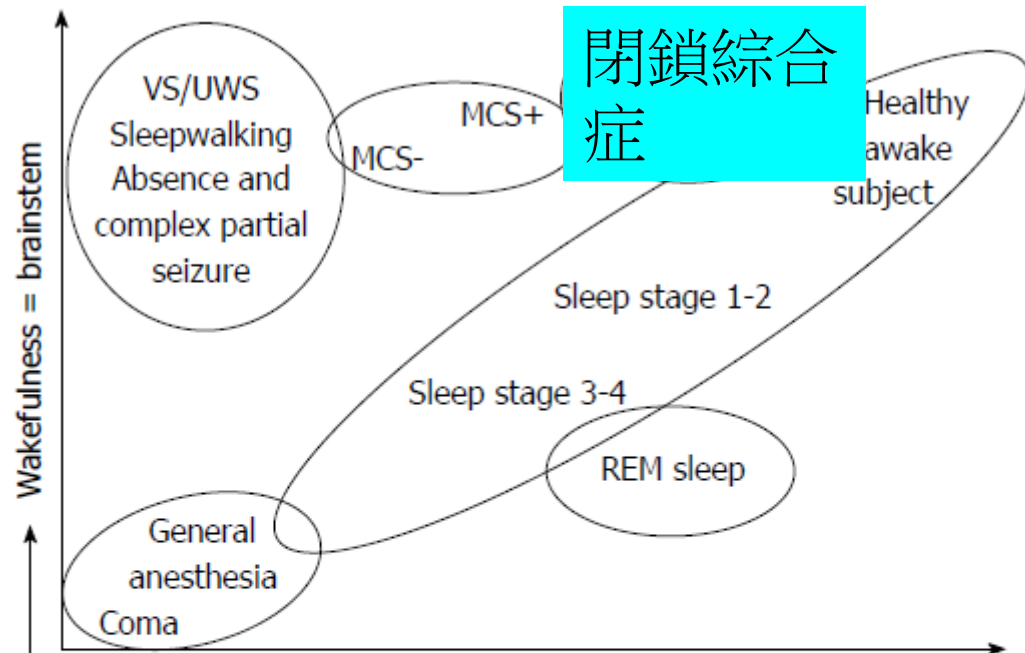


體外覺察

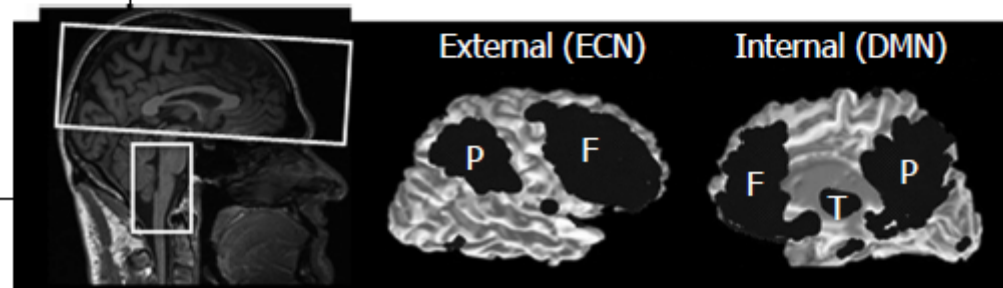
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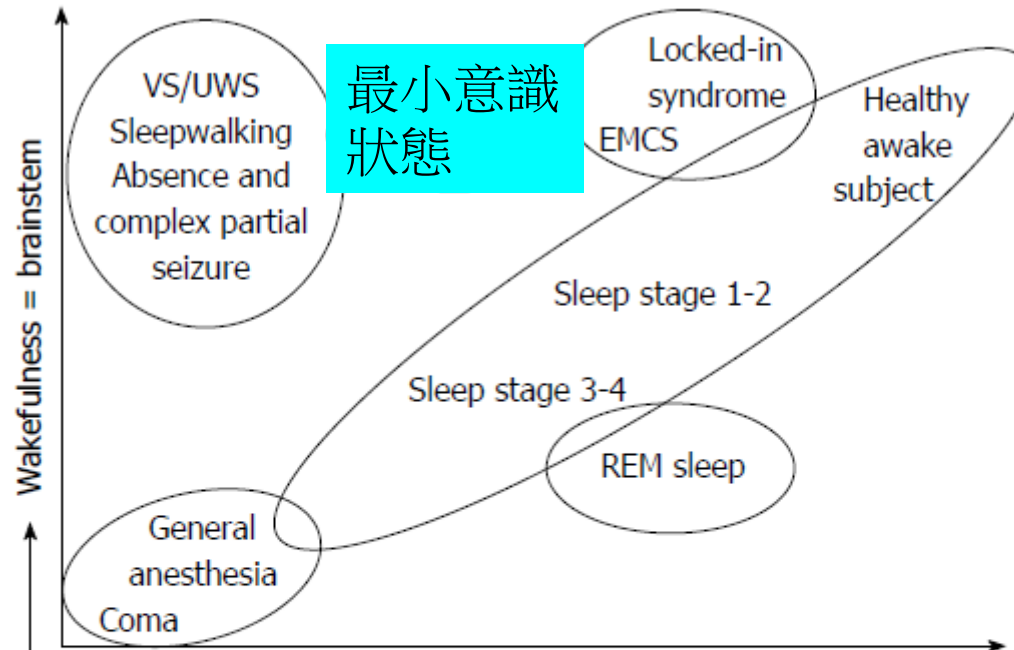


體外覺察

體內覺察

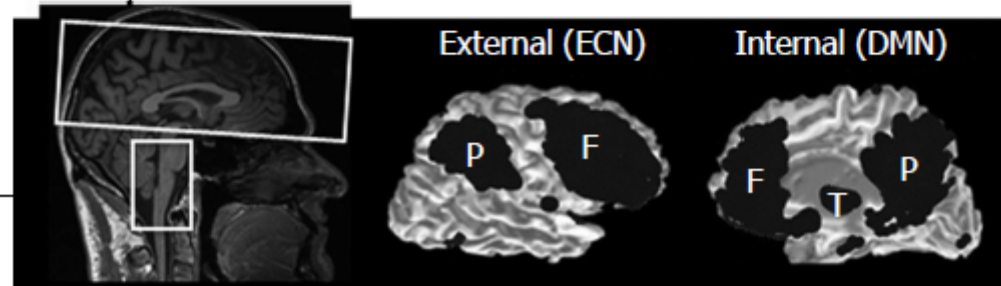
覺醒 Wakefulness 和 覺察 Awareness

覺醒 = 腦幹



最小意識狀態

覺察 = “大腦皮層”連接“丘腦”網絡

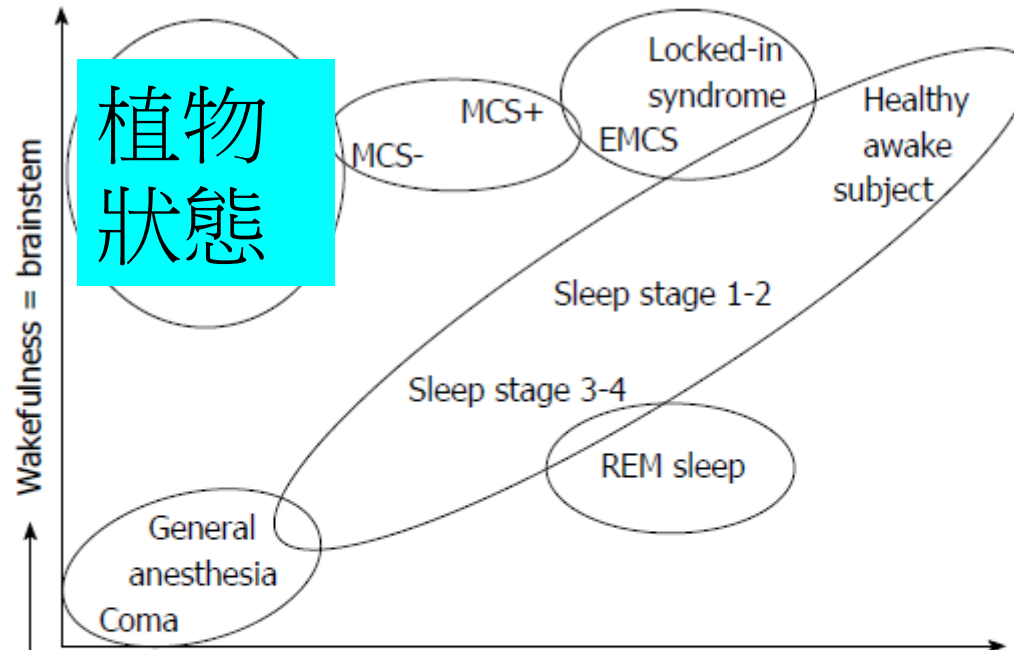


體外覺察

體內覺察

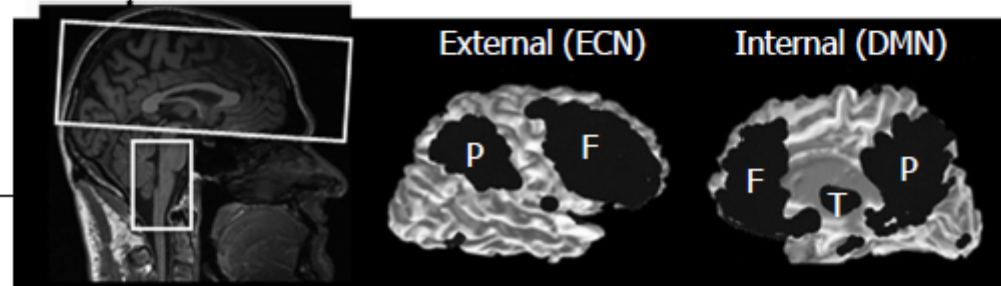
覺醒 Wakefulness 和 覺察 Awareness

覺醒 = 腦幹



植物狀態

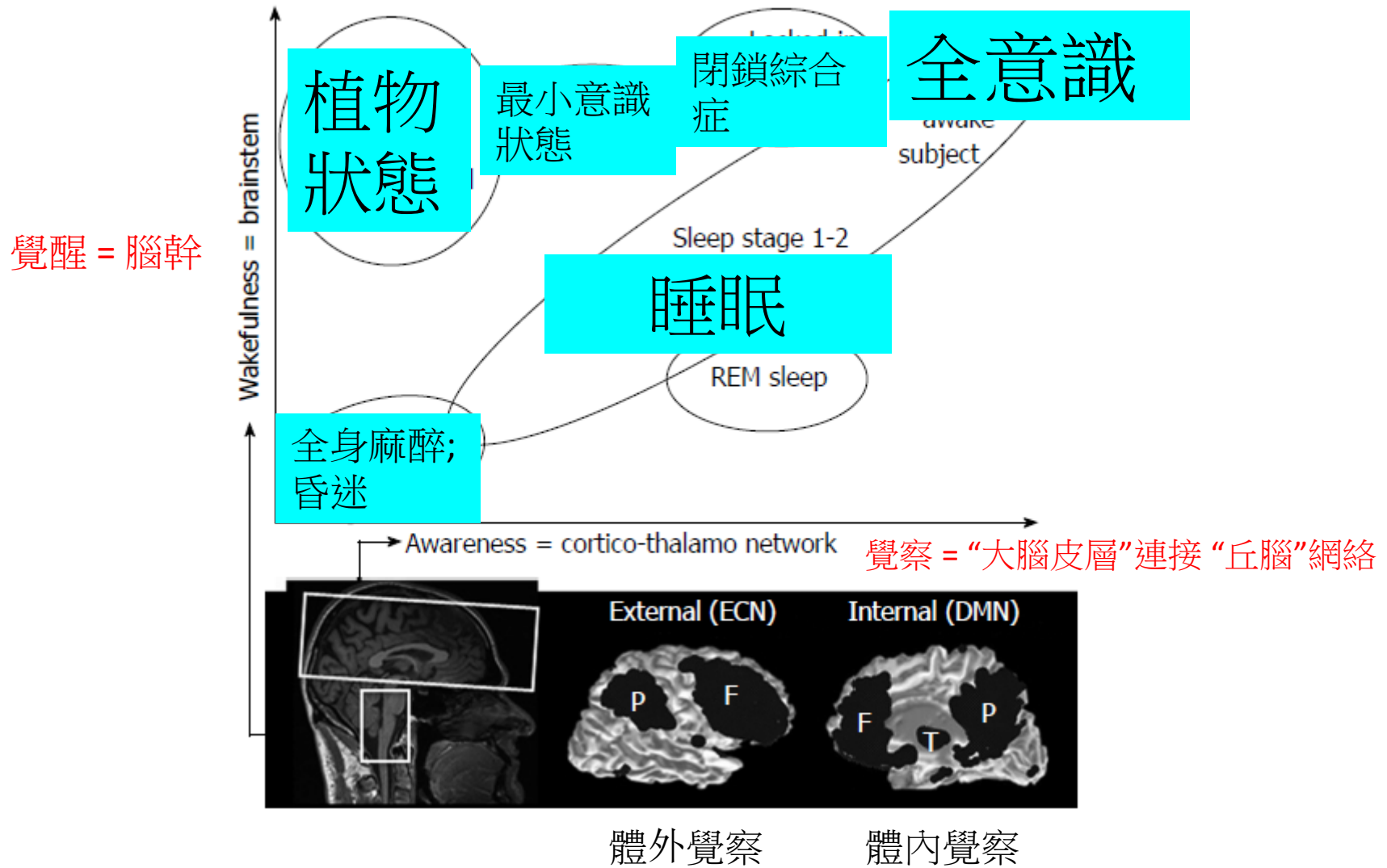
覺察 = “大腦皮層”連接“丘腦”網絡



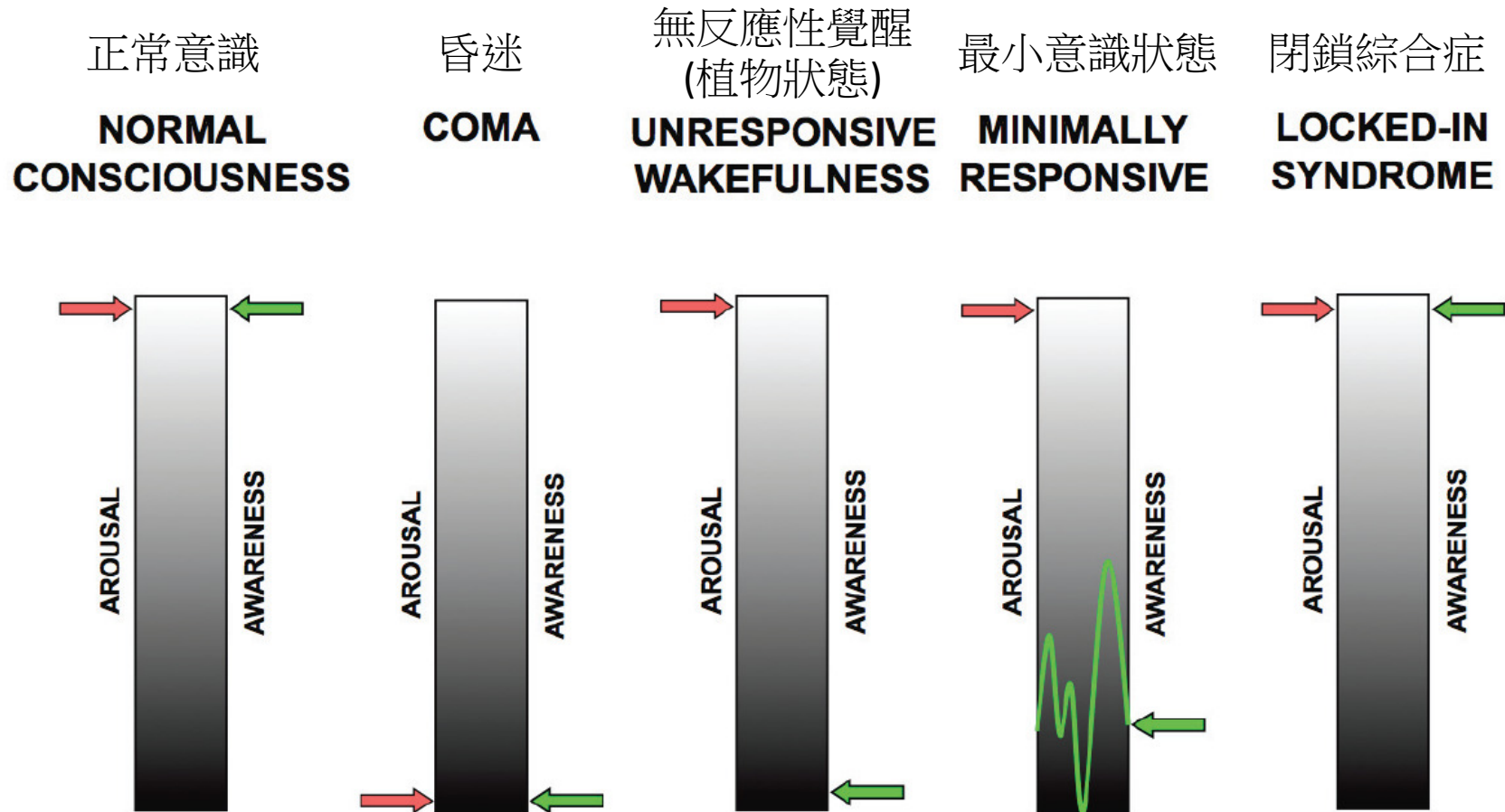
體外覺察

體內覺察

覺醒 Wakefulness 和 覺察 Awareness

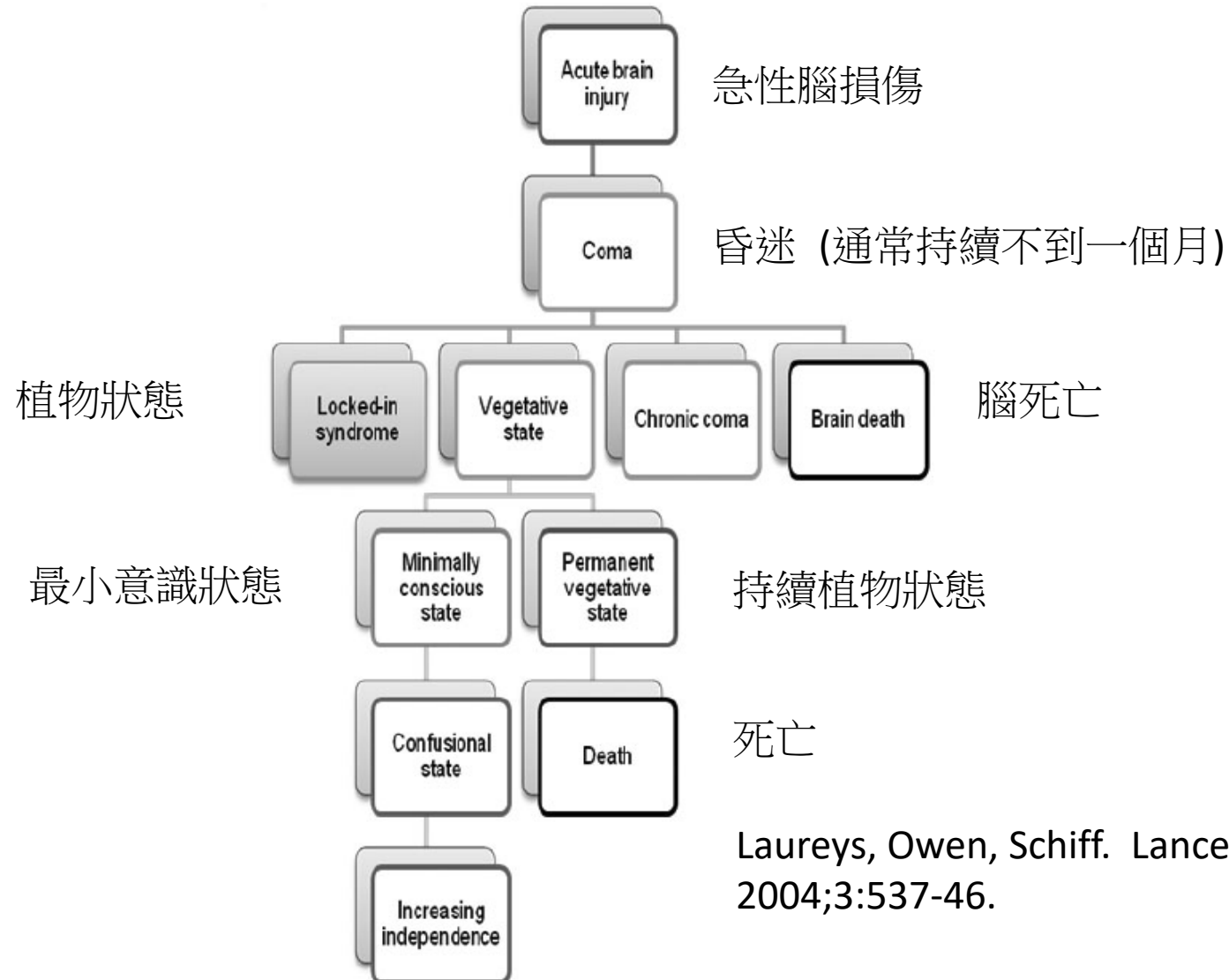


覺醒 Wakefulness 和 覺察 Awareness



Laureys, Owen, Schiff. Lancet Neurol 2004;3:537-46.

腦損傷進程 Course of Brain Injury



Laureys, Owen, Schiff. Lancet Neurol 2004;3:537-46.

昏迷原因

Classification and causes of coma

結構性腦損傷

Structural brain injury

Cerebral hemisphere

UNILATERAL (WITH DISPLACEMENT)

Intraparenchymal hematoma

Middle cerebral artery ischemic stroke

Intracranial venous thrombosis

Hemorrhagic contusion

Cerebral abscess

Brain tumor

Subdural or epidural hematoma

BILATERAL

Subarachnoid hemorrhage

Multiple traumatic brain contusions

Penetrating traumatic brain injury

Anoxic-ischemic encephalopathy

Multiple cerebral infarcts

Bilateral thalamic infarcts

Lymphoma

Encephalitis

Gliomatosis

Acute disseminated encephalomyelitis

Cerebral edema

Multiple brain metastases

Acute hydrocephalus

Acute leukoencephalopathy

Posterior reversible encephalopathy syndrome

Air or fat embolism

BRAINSTEM

Pontine hemorrhage

Basilar artery occlusion and brainstem infarct

Central pontine myelinolysis

Brainstem contusion

CEREBELLUM (WITH DISPLACEMENT OF BRAINSTEM)

Cerebellar infarct

Cerebellar hematoma

Cerebellar abscess

Cerebellar glioma

Acute metabolic-endocrine disturbance

Hypoglycemia

Hyperglycemia (nonketotic hyperosmolar)

Hyponatremia

Hypernatremia

Hypocalcemia

Acute hypothyroidism

Acute panhypopituitarism

Acute uremia

Hyperammonemia

Hypercapnia

Diffuse physiologic brain dysfunction

Generalized tonic-clonic seizures

Poisoning, illicit drug use

Hypothermia

Gas inhalation

Acute catatonia

Malignant neuroleptic syndrome

Functional Coma

Pseudostatus epilepticus

Eyes closed unresponsiveness to stimuli

急性代謝或內分泌
損傷

瀰漫性腦功能障礙

假昏迷

各種意識障礙的行為反應

行為反應	最小意識狀態	植物狀態	昏迷
Behavior	MCS	VS	Coma
Eye opening 眼睛睜開	Spontaneous 自發	Spontaneous 自發	None
Spontaneous movement 自發活動	Automatic/object manipulation 自動操縱	reflexive/patterned 反射	None
Response to pain 對疼痛的反應	Localization 定位	Posturing/withdrawal 神經退行反應	Posturing/None
Visual response 視覺反應	Object recognition/pursuit 視覺跟踪	Startle/pursuit (rare) 驚嚇	None
Affective response 情感反應	Contingent 附隨	Random 隨機	None
Commands 對命令反應	Inconsistent 不符	None 沒有	None
Verbalization 語言	Intelligible words 可理解的詞	Random vocalization 隨機聲音	None

沒有反應

Clinical entities	DOC	Definition
Coma (Plum & Posner 1983)	Yes	No wakefulness No awareness of self or environment
Vegetative state/unresponsive wakefulness syndrome (Laureys et al. 2010, Multi-Society Task Force on PVS 1994a)	Yes	Wakefulness No awareness of self or environment No sustained, reproducible, purposeful behavioral responses to external stimuli No language comprehension or expression Relatively preserved hypothalamic and brain stem autonomic functions Bowel and bladder incontinence Variably preserved cranial-nerve and spinal reflexes
Minimally conscious state (Bruno et al. 2011b, Giacino et al. 2002)	Yes	Wakefulness Fluctuating awareness with reproducible, purposeful behavioral responses to external stimuli
Minimally conscious state minus	Yes	Visual pursuit Reaching for objects Orientation to noxious stimulation Contingent behavior
Minimally conscious state plus	Yes	Following commands Intentional communication Intelligible verbalization
Emergence from minimally conscious state (Giacino et al. 2002)	No	Functional communication Functional object use
Locked-in syndrome (American Congress of Rehabilitation Medicine 1995)	No	Wakefulness Awareness Aphonia or hypophonia Quadriplegia or quadriplegia Presence of communication through the eyes Preserved cognitive abilities

DOC, disorders of consciousness.

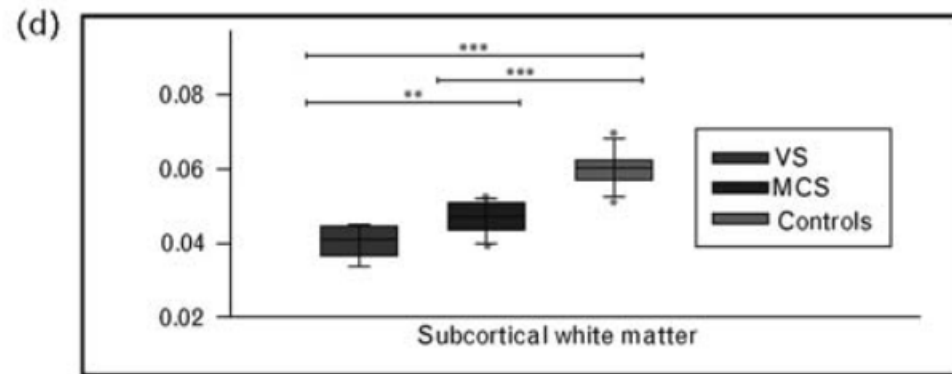
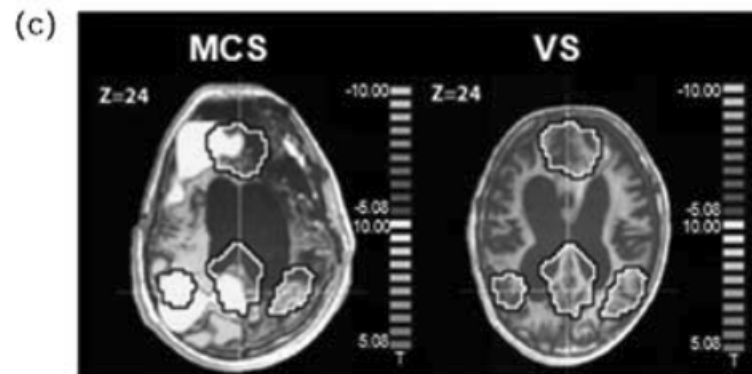
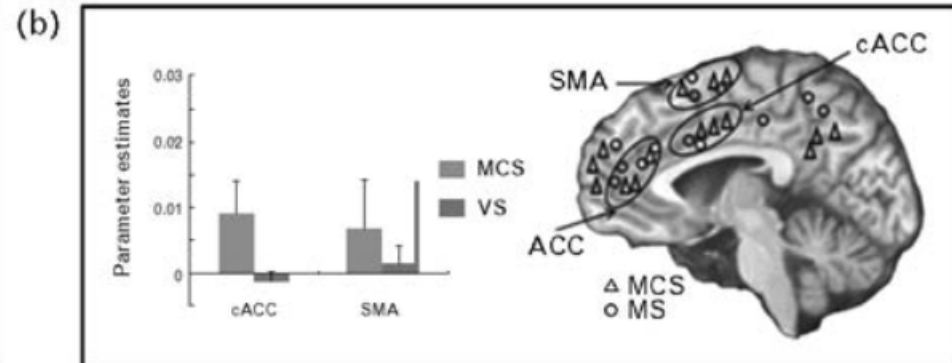
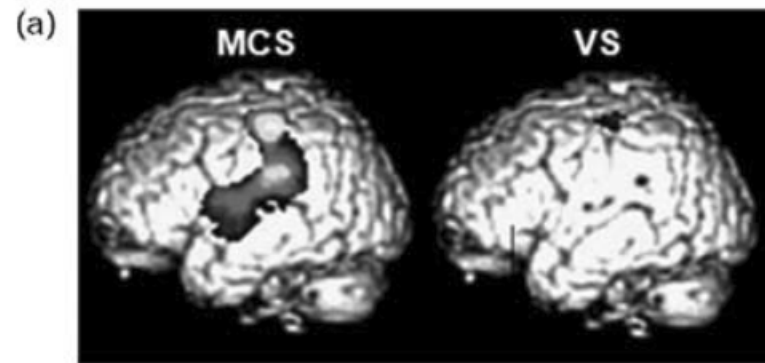
Gosseries et al, Annual Review of Neuroscience 2014

各種意識障礙的行為反應

	覺醒	覺察	張開眼睛	對外部刺激的反應	溝通
昏迷	-	-	-	-	-
植物狀態	+	-	+	-	-
最小意識狀態	+	±	+	±	±
最小意識狀態減	+	±	+	±	±
最小意識狀態加	+	+(-)	+	+(-)	+(-)

對外部刺激的反應

Population level: MCS > VS

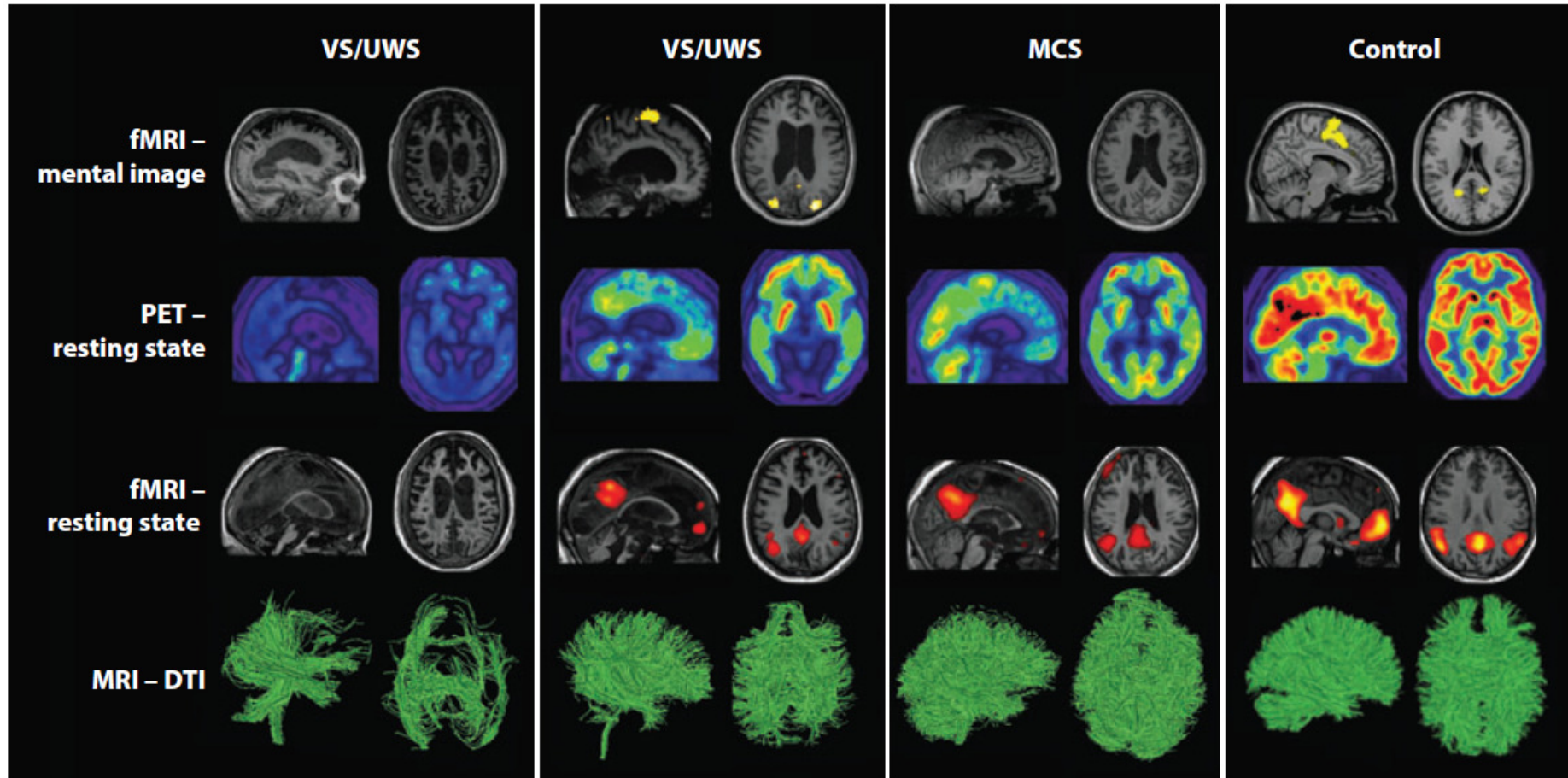


各種意識障礙的大腦活動

植物狀態

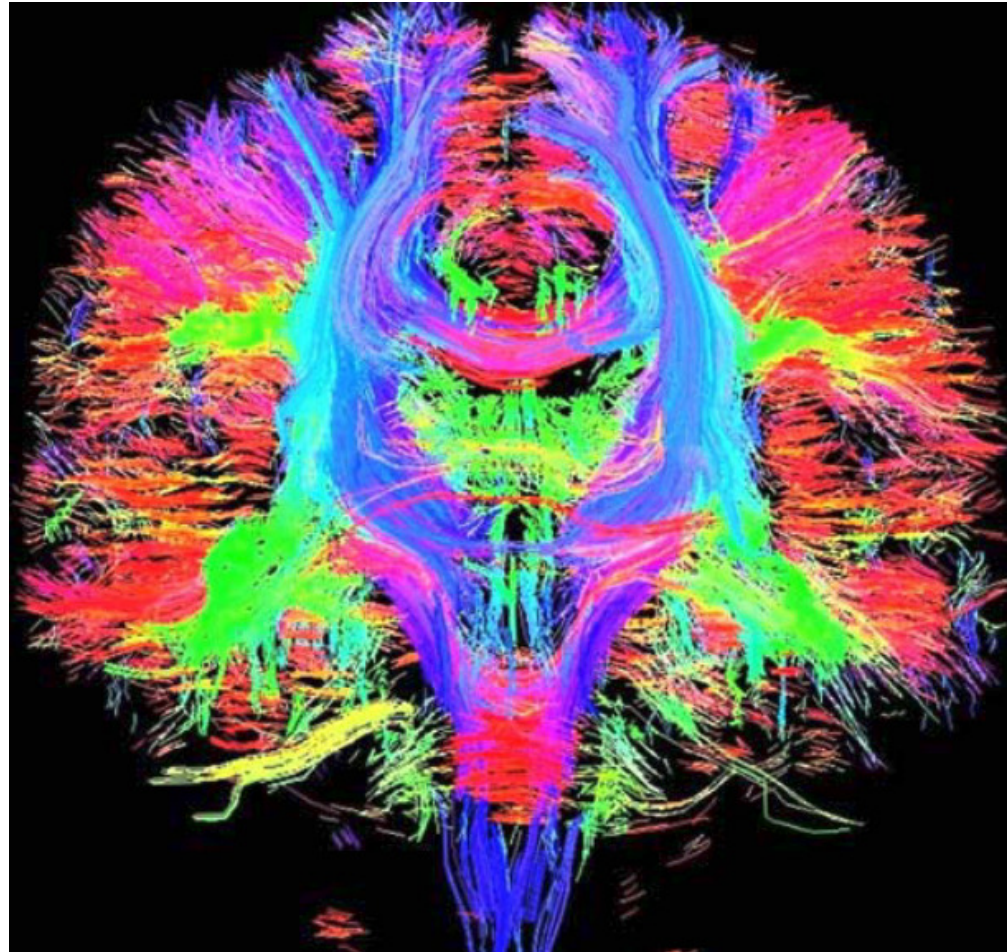
最小意識狀態

正常



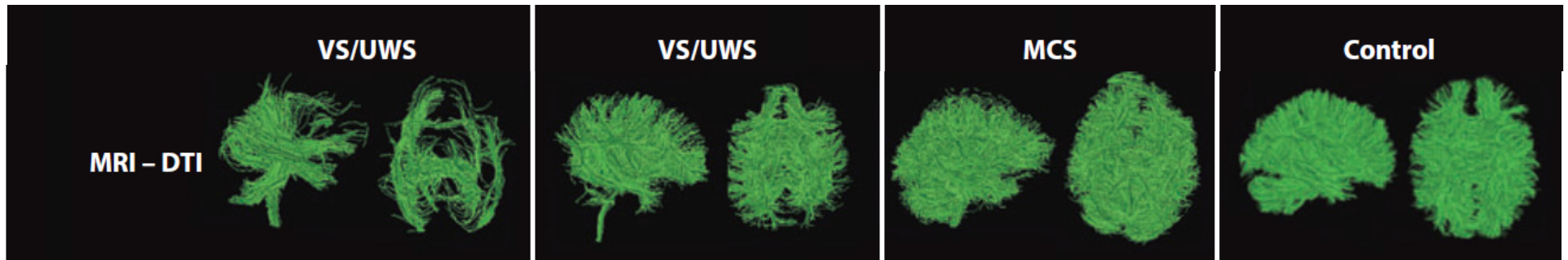
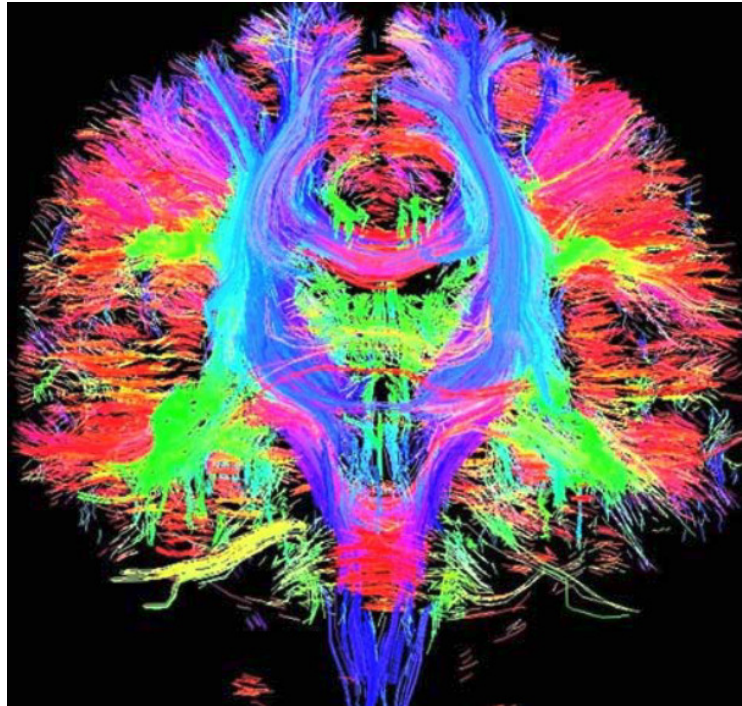
擴散張量成像

Diffusion Tensor Imaging DTI



Tshibanda et al. *Neuroradiology* 2010;52:15-24

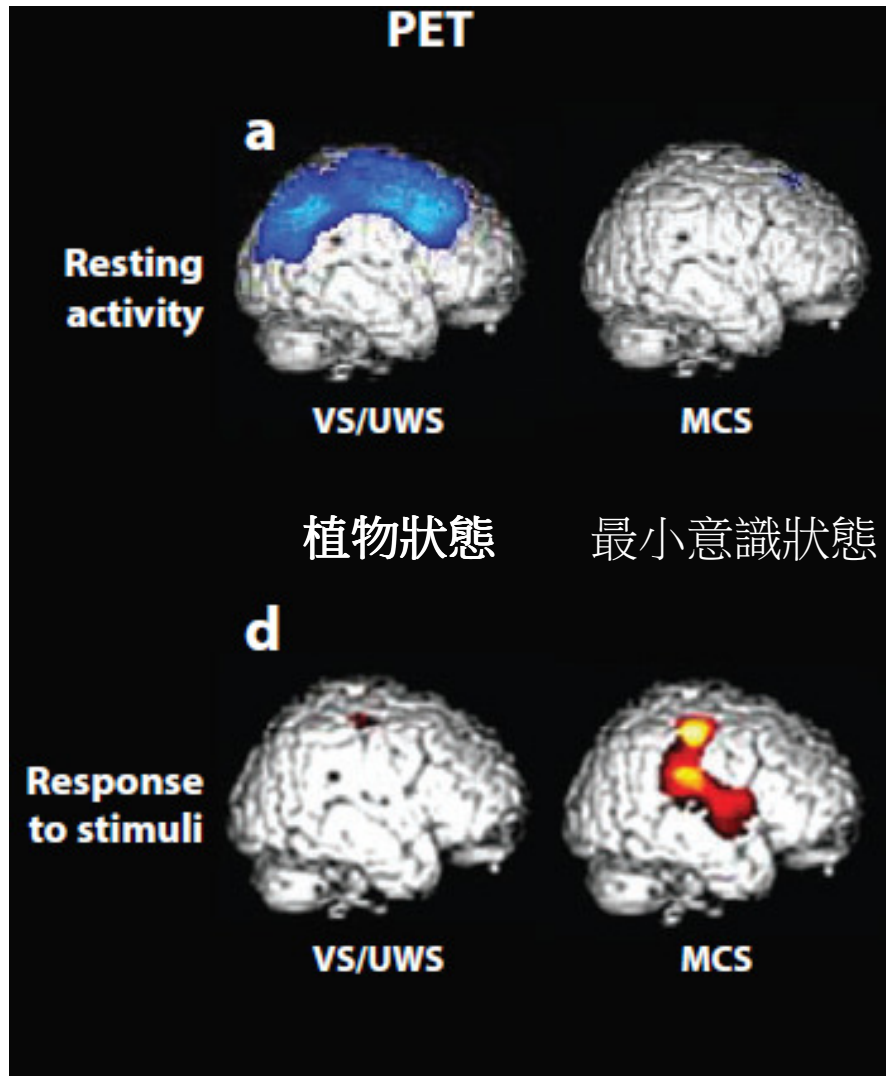
擴散張量成像



Gosseries et al, Annual Review of Neuroscience 2014

各種意識障礙的大腦活動

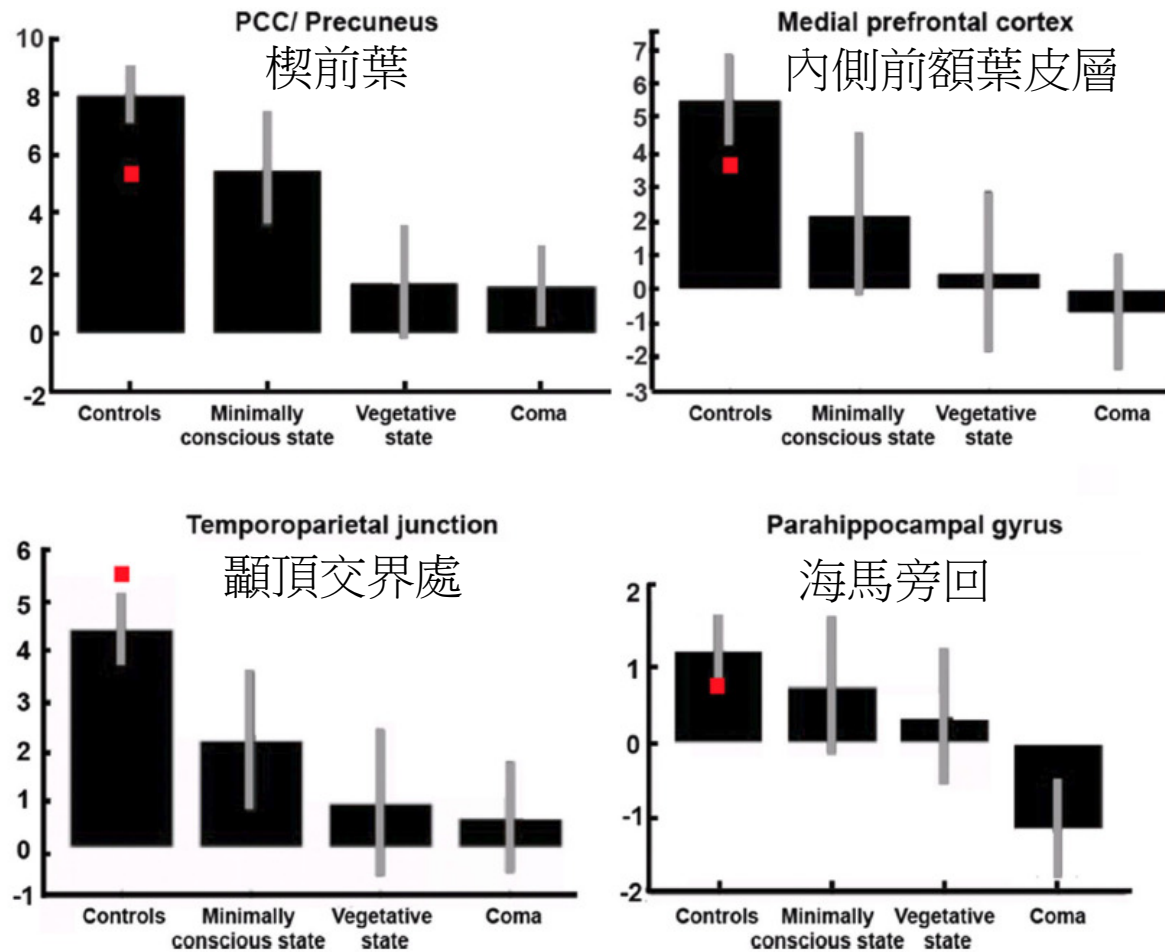
休息狀態



對外部刺激的反應

Default Mode Network 默認模式網絡

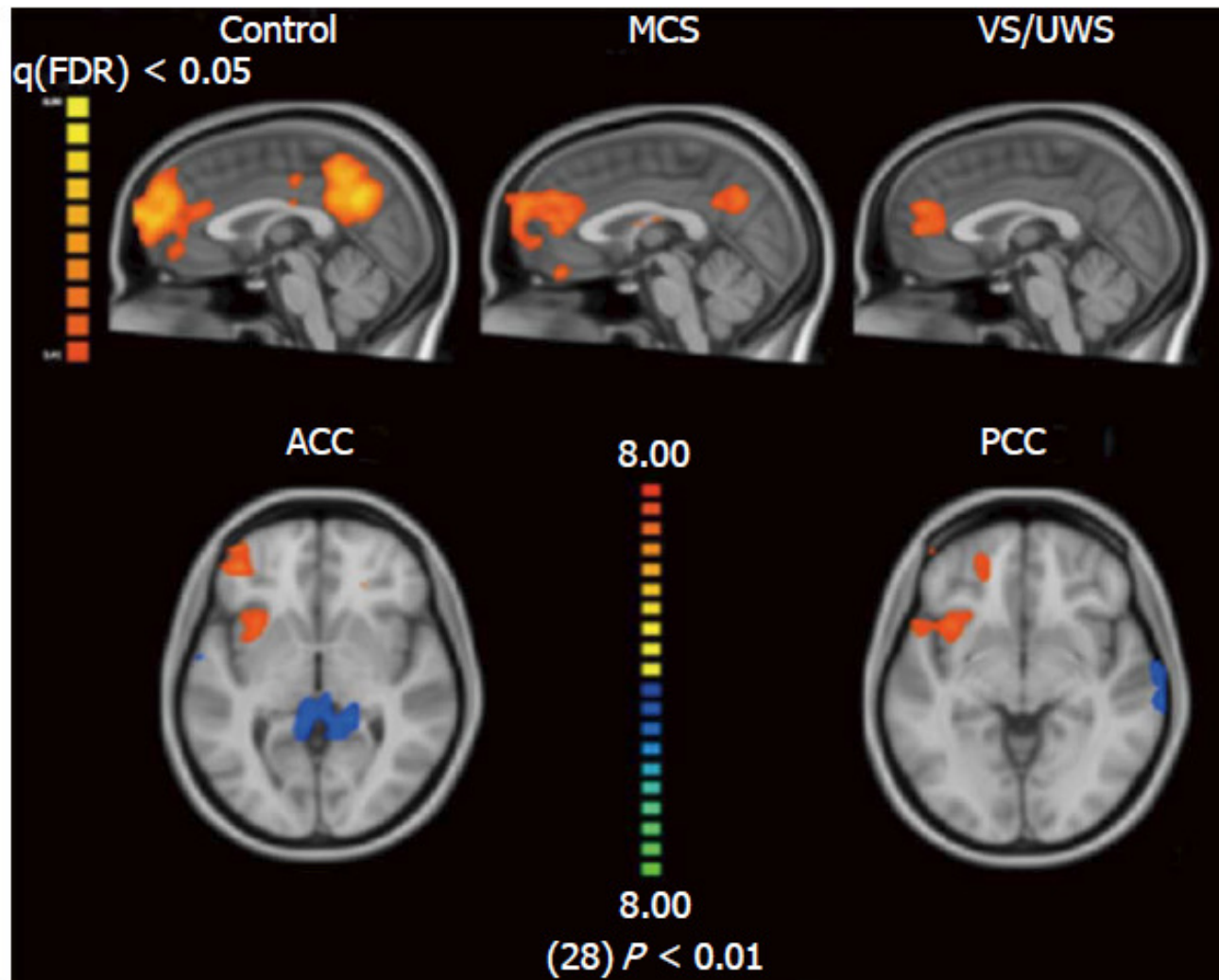
Connectivity strength (mean z scores with 90% confidence interval)



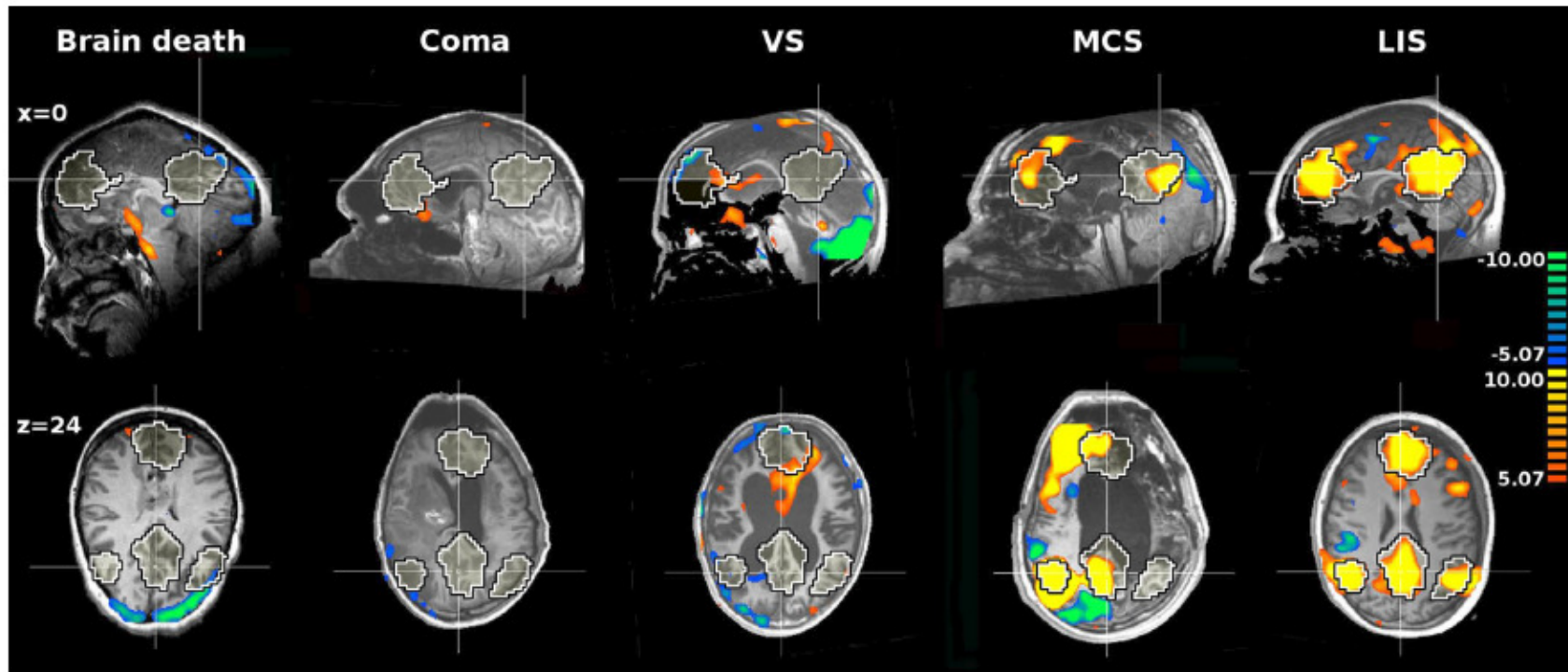
在各種意識障礙中不同的大腦活動

Vanhaudenhuyse et al. JNNP 2009; Demertzi et al. Frontiers Psychol 2011.

Default Mode Network 默認模式網絡



Internal Network 內部網絡

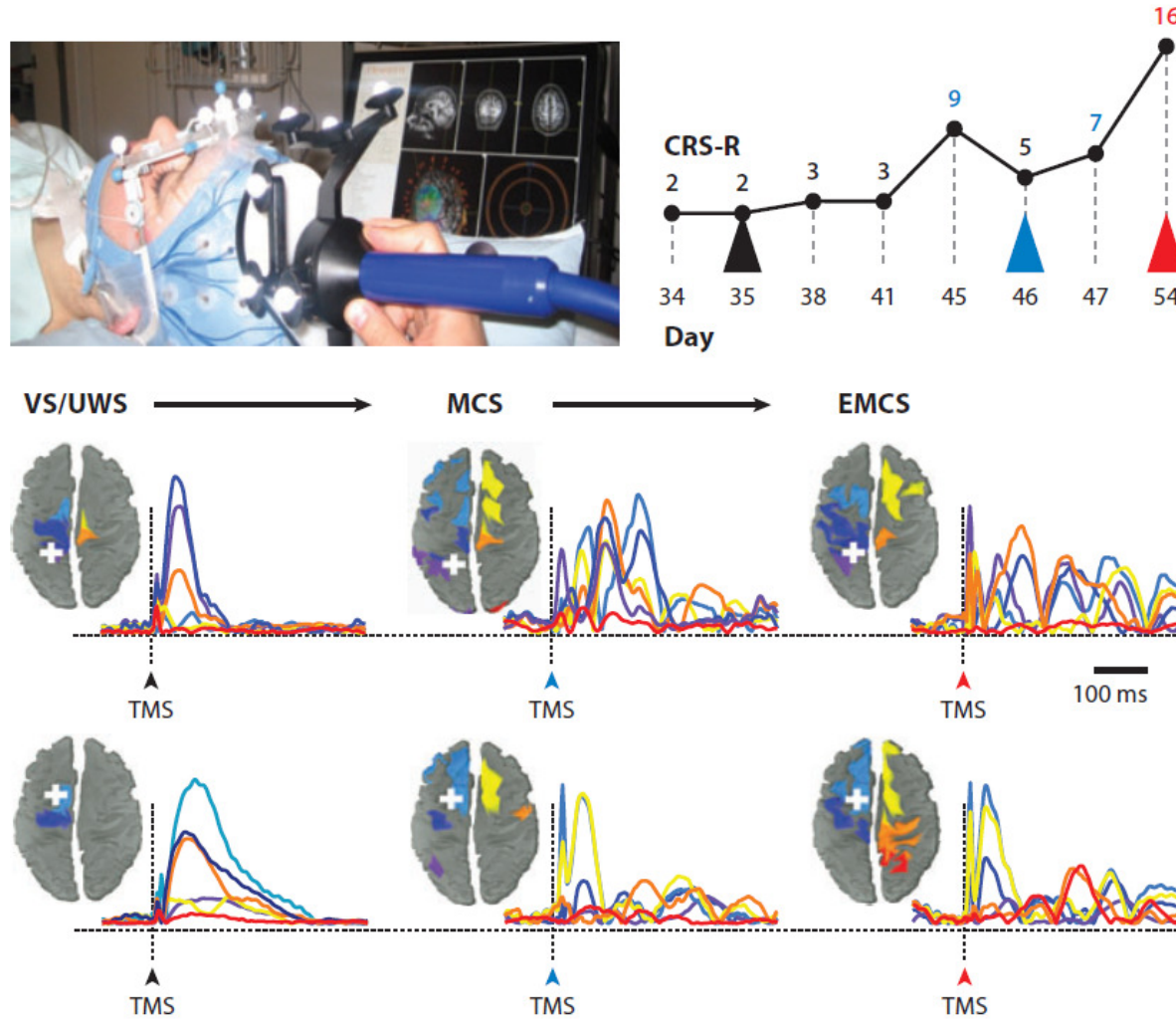


在各種意識障礙中不同的大腦活動

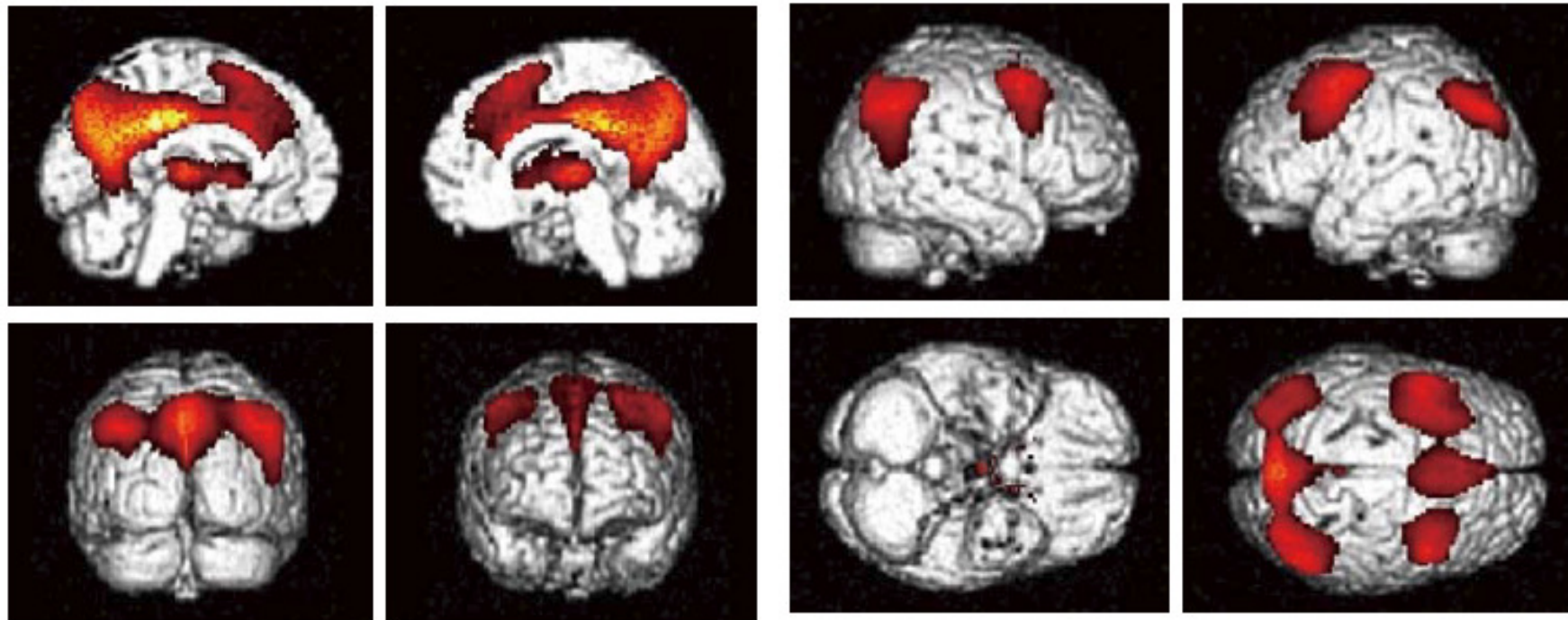
FIGURE 2 | The internal network of patients with brain death, coma, vegetative state (VS), minimally conscious state (MCS), and Locked-in syndrome (LIS). The network was extracted with ICA. The black and white contour represents a template of the internal network extracted from 11

awake healthy subjects with ICA. Yellow and orange colors represent the areas which activities positively correlate with the time course of the internal network. The figure is based on data from Boly et al. (2009) and Vanhaudenhuyse et al. (2010b).

經顱磁刺激和腦電圖 識別不同的意識狀態



植物狀態和最小意識狀態下 腦代謝減少的區域



Di Perri et al. World J Radiology 2014

各種意識障礙的大腦活動反應

腦電圖

誘發電位

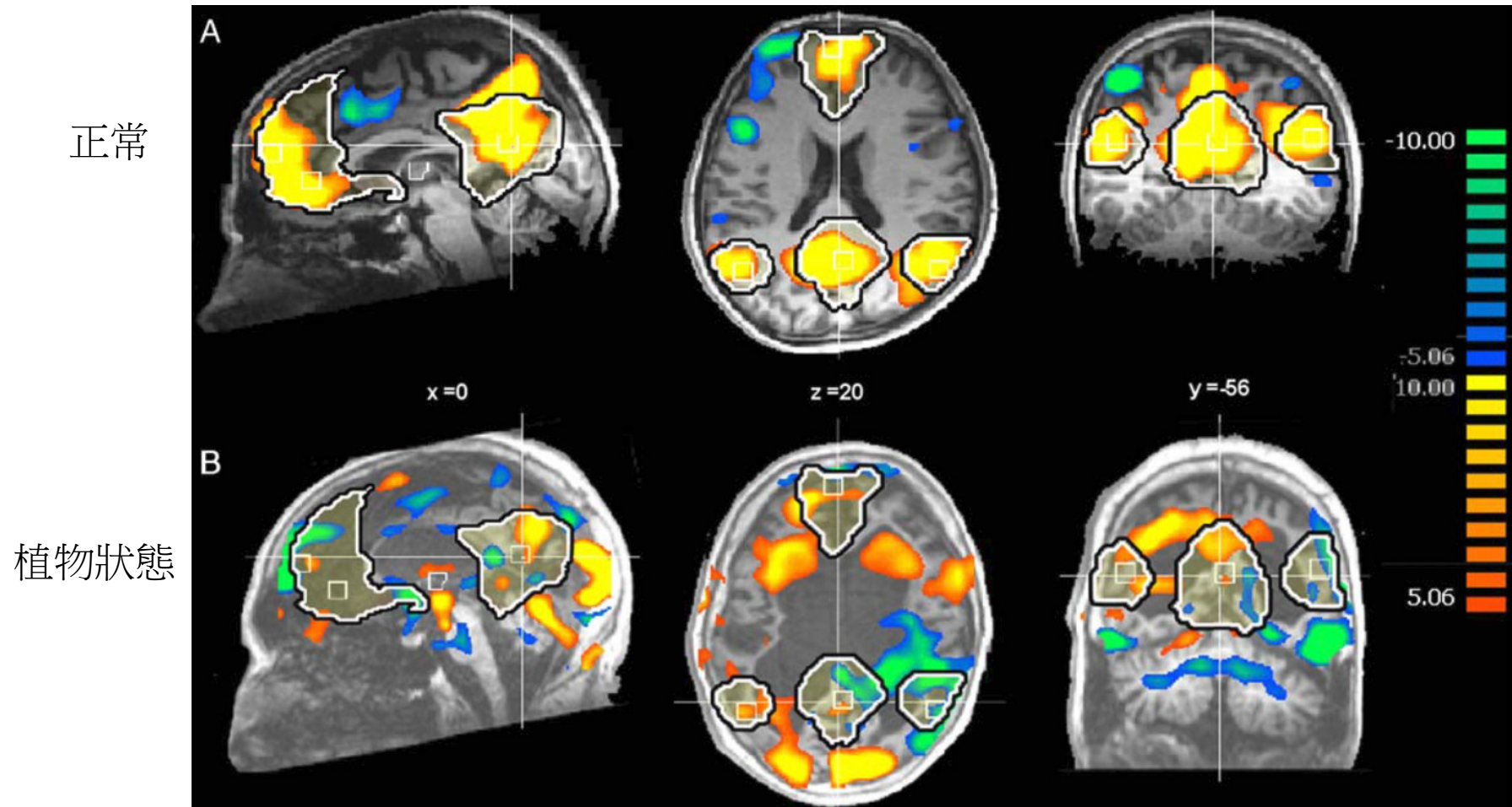
正電子掃描/磁共振

	EEG	Evoked potentials	PET/fMRI	Comment
Brain death	Electrocerebral silence	Absent	Absent cortical metabolism	Legally dead in most jurisdictions
Coma	Polymorphic delta, burst-suppression	BAER variable; cortical ERPs often absent	Resting <50%	Prognosis variable
Vegetative state	Delta, theta, or electrocerebral silence	BAER preserved; cortical ERPs variable	Resting <50%; primary areas can be stimulated	Prognosis variable
Minimally conscious state	Non-specific slowing	BAER preserved; cortical ERPs often preserved	Reduced; secondary areas can be stimulated	Prognosis variable
Locked-in syndrome	Usually normal	BAER variable; cortical ERPs normal	Normal or nearly normal	Not a disorder of consciousness

Bernat JL. Lancet 2006;367:1181-92

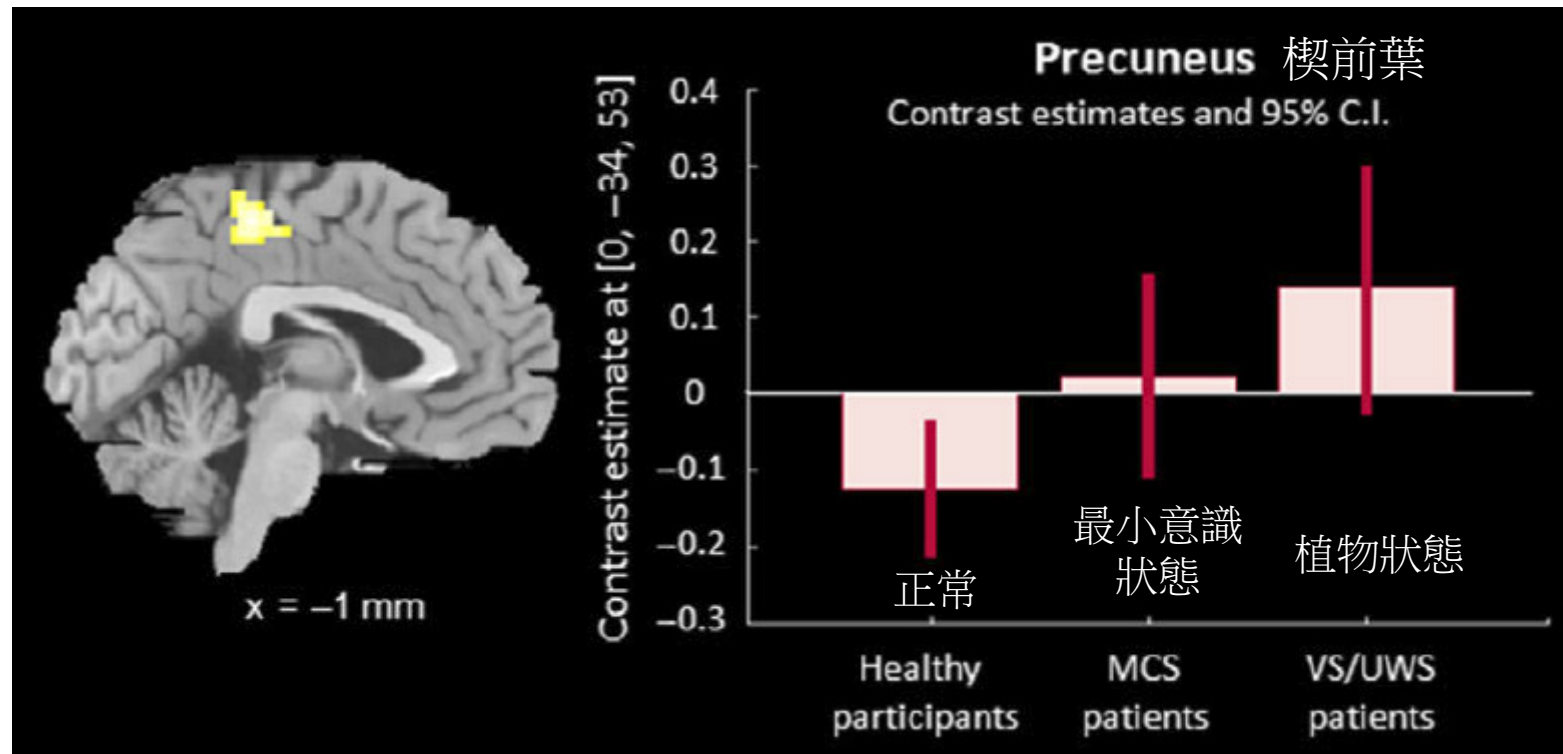
休息狀態回波平面成像

Resting state Echo Planar Imaging



Tshibanda et al. *Neuroradiology* 2010;52:15-24

嗅覺功能



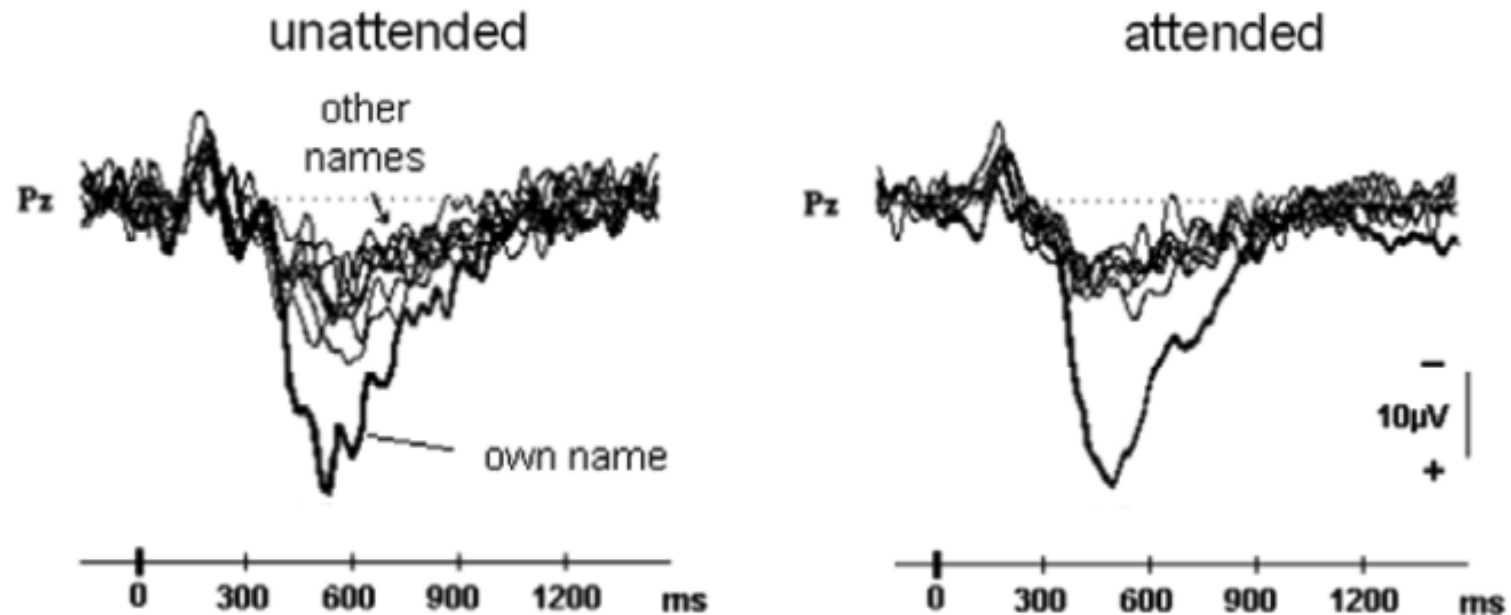
Nigri et al. Euro J Neurol 2016;23:605-612.

事件相關電位 Event Related Potential

OWN NAME

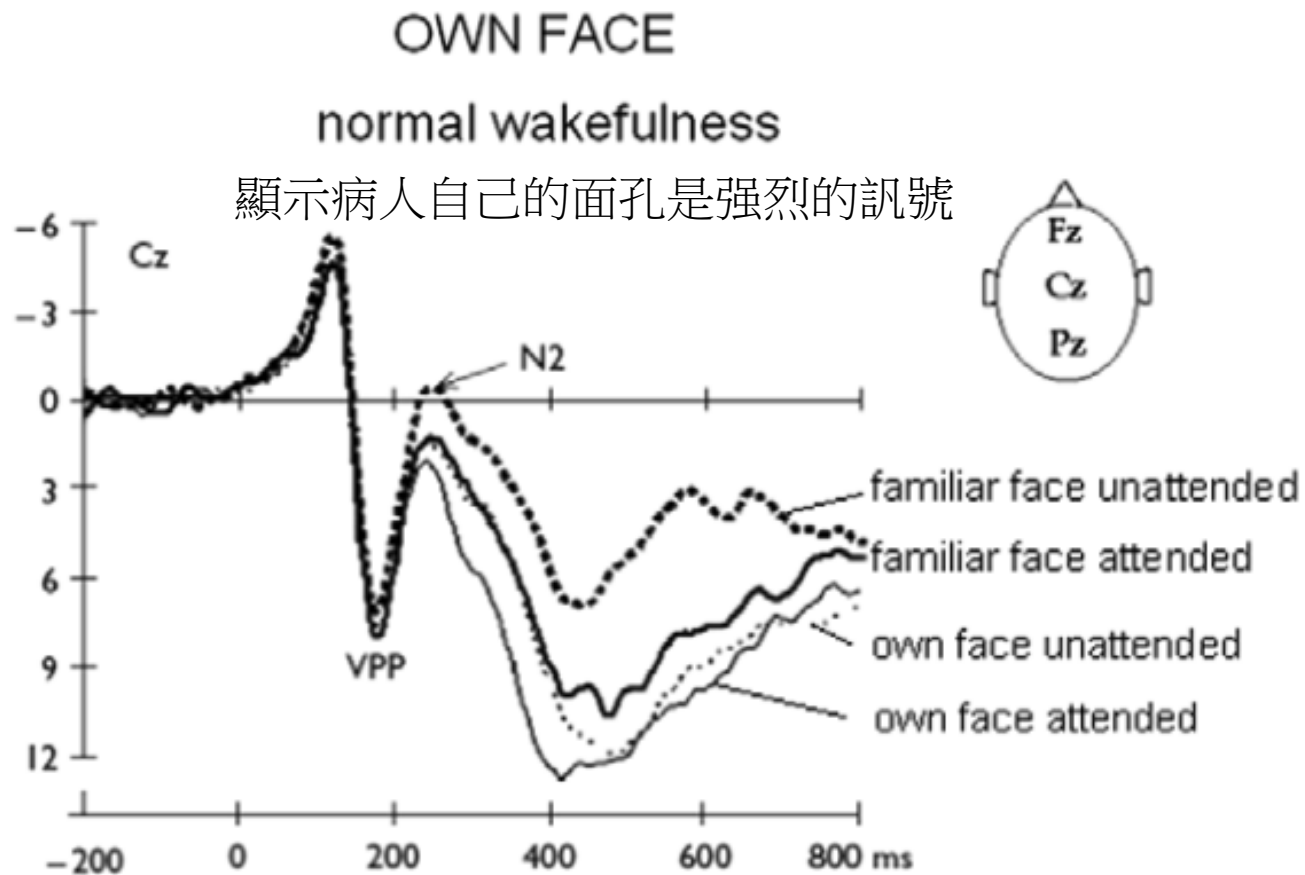
normal wakefulness

叫喚病人的名字是強烈的訊號



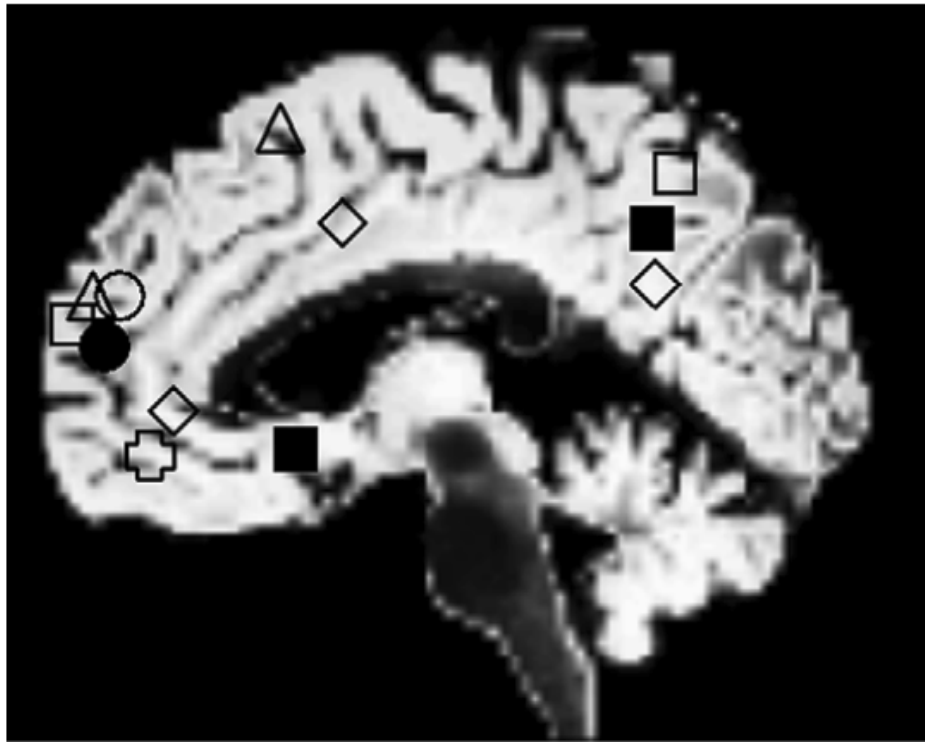
Laureys et al. Conscious Cognition 2007;16:722-41

事件相關電位 Event Related Potential



Laureys et al. Conscious Cognition 2007;16:722-41

病人自己的名字和面孔 是強烈的訊號



OWN NAME

- 15 controls: Perrin et al. 2005
- △ 16 controls: Kampe et al. 2003
- 3 controls: Staffen et al. 2006
- 1 MCS patient: Laureys et al. 2004
- 1 VS patient: Staffen et al. 2006

OWN FACE

- ⊕ 12 controls: Platek et al. 2006
- ◇ 6 controls: Kircher et al. 2001

昏迷及各種意識障礙：康復的機會

- 創傷會比非創傷較易康復 **Traumatic better than non-traumatic**
- 意識障礙的時間愈久，康復的機會越低
Longer the state, worse the chance of recovery:
 - 非創傷者，三個月後，少於1% 能康復
 - 創傷者，十二個月後，少於1% 能康復
 - < 1% in non-traumatic vegetative cases by 3 months and traumatic by 12 months
- 植物狀態的死亡率 **Mortality of vegetative state:**
 - 到了三年，70% 死亡 (70% at 3 years)
 - 到了五年，84% 死亡 (84% at 5 years)

Multi-Society Task Force on PVS, NEJM 1994, 1995.

昏迷及各種意識障礙：康復的機會

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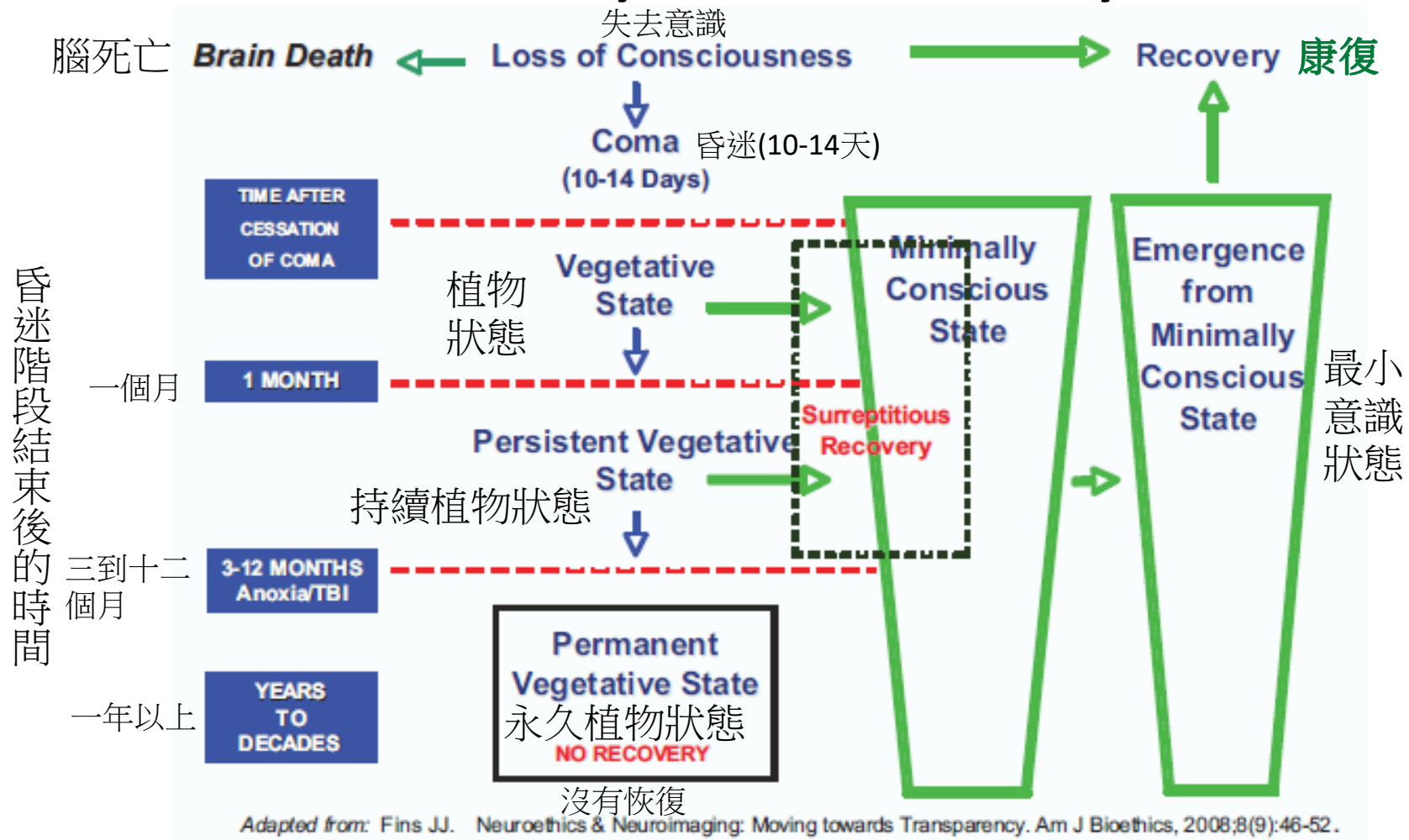
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- 意識障礙的時間愈久，康復的機會越低Longer the state, worse the chance of recovery:
 - 非創傷者，三個月後，少於1%能康復
 - 創傷者，十二個月後，少於1%能康復
 - < 1% in non-traumatic vegetative cases by 3 months and traumatic by 12 months
- 植物狀態的死亡率Mortality of vegetative state:
 - 到了三年，70%死亡 (70% at 3 years)
 - 到了五年，84%死亡 (84% at 5 years)

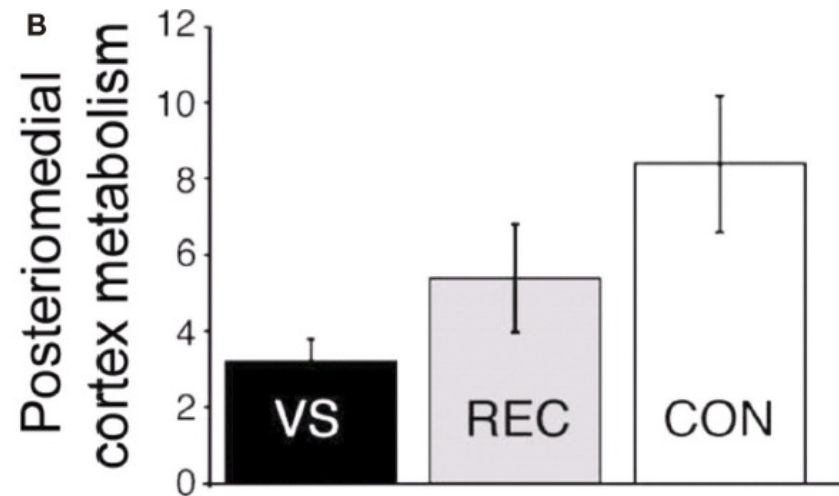
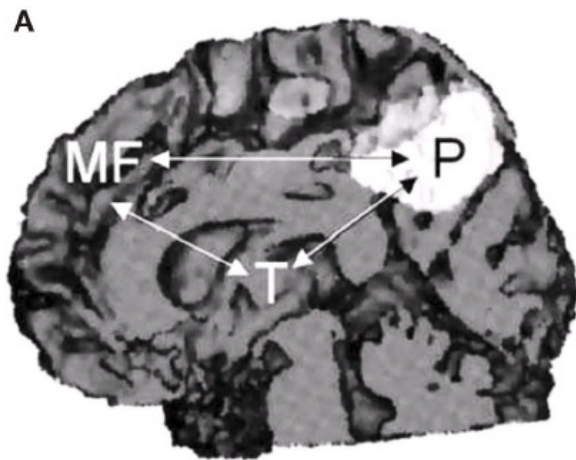
Multi-Society Task Force on PVS, NEJM 1994, 1995.

復康之路

Pathways to Recovery



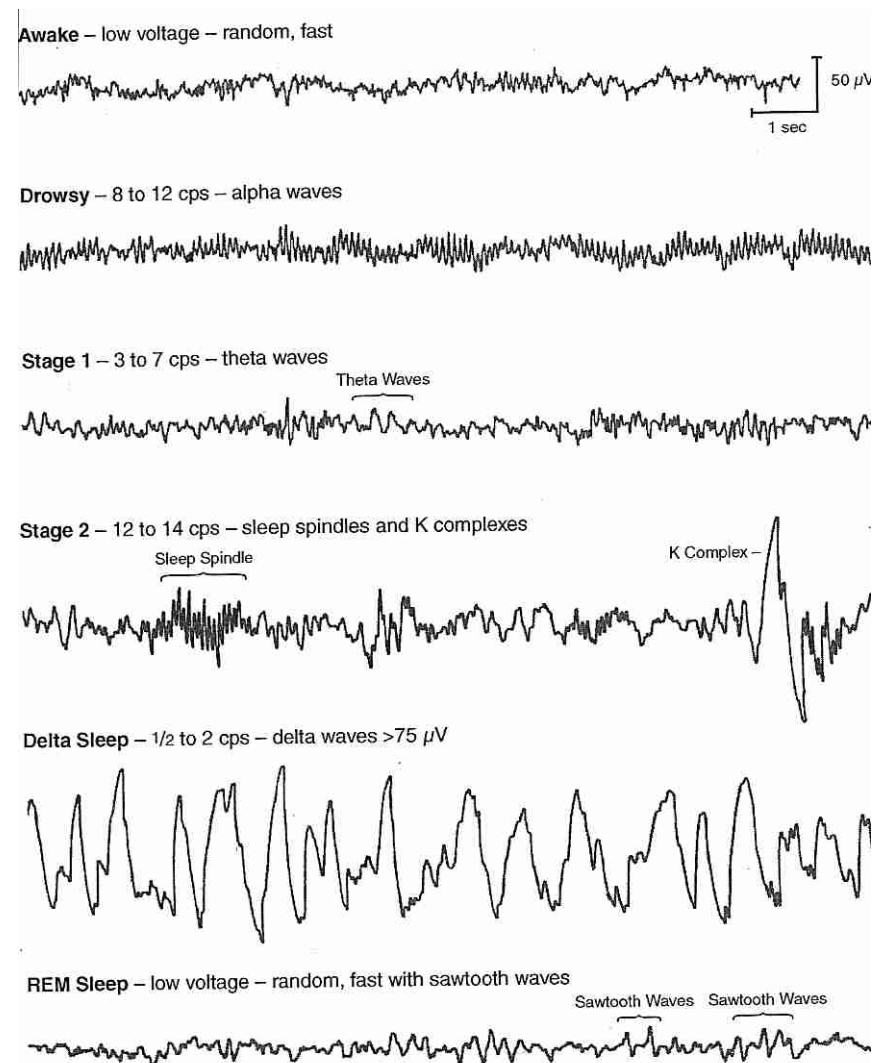
植物狀態康復跡像： 後內側大腦皮層糖代謝活動上升



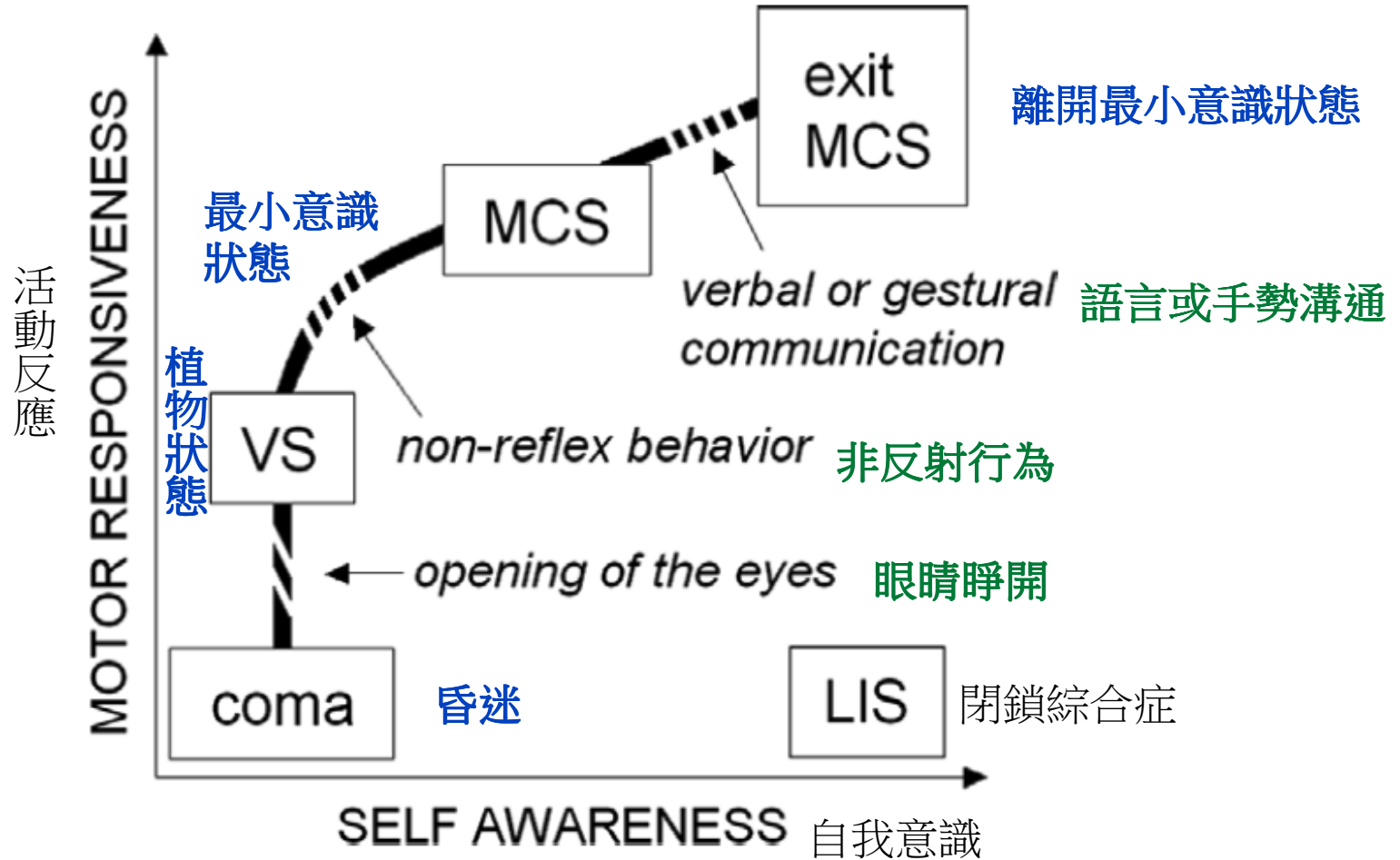
Laureys et al. J Clin Investigation 2006

昏迷: 改善的跡象

- 如果腦電圖顯示睡眠模式，那麼這可能是改善的跡象



復甦跡象



照顧意識障礙患者

- 確定原因 Identify the cause
- 具體治療原因 Specific management of cause
- 預防並發症 Prevent complications
- 治療並發症 Treat complications
- 營養 Nutrition
- 促進康復 Facilitate recovery
- 康復運動 Rehabilitation
- 盡各種方式保護患者 Protect the patient in every way!

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經皮內鏡胃造口術

Percutaneous endoscopic gastrostomy



Wijdicks EFM. Handbook of Clinical Neurology 2017;140:117-129

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允許言語恢復患者發聲的氣管造口



Wijdicks EFM. Handbook of Clinical Neurology 2017;140:117-129

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天主教會的立場

照顧意識障礙患者的原則

天主教會的立場



The Holy See

*ADDRESS OF JOHN PAUL II
TO THE PARTICIPANTS IN THE INTERNATIONAL CONGRESS
ON "LIFE-SUSTAINING TREATMENTS AND VEGETATIVE STATE:
SCIENTIFIC ADVANCES AND ETHICAL DILEMMAS"*

Saturday, 20 March 2004

- 於不同程度的意識障礙或具體處境中，人的尊嚴都依然確實存在。
- 適當的給予意識障礙患者水和養料是基本維持生命的需要。



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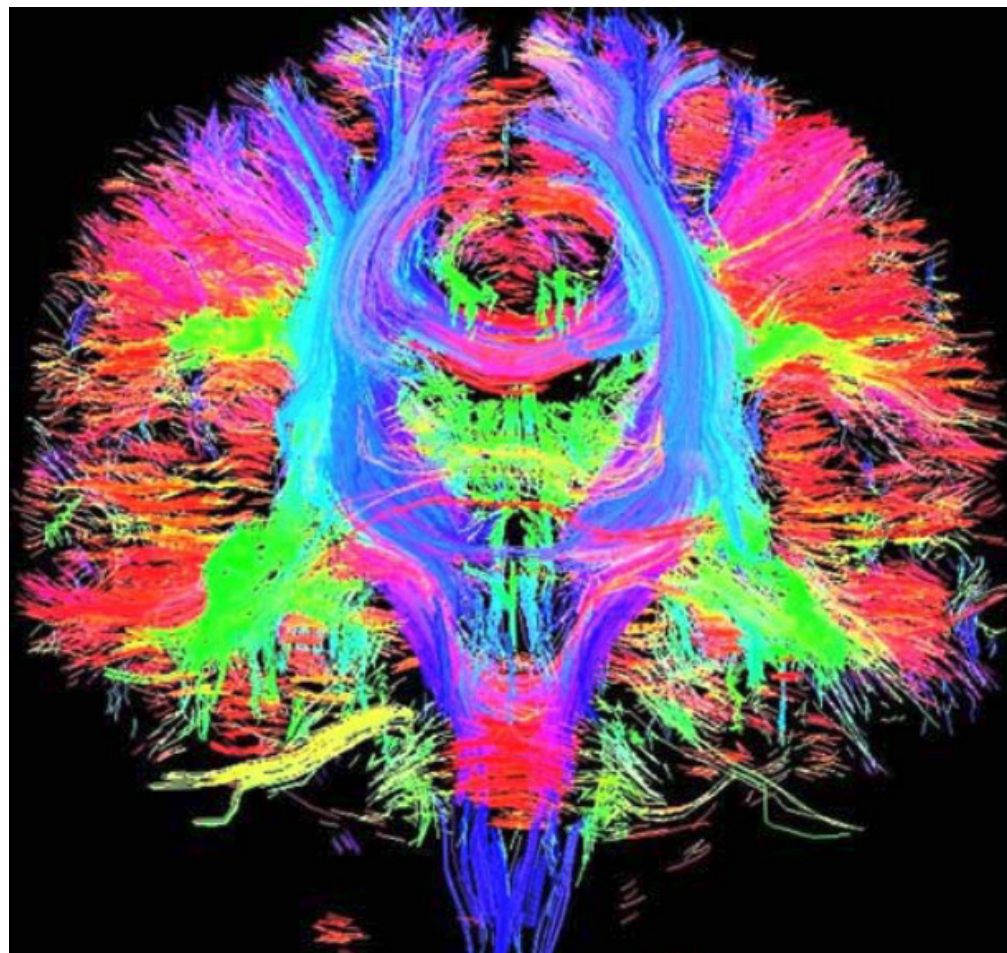
7. Distinguished Ladies and Gentlemen, in conclusion I exhort you, as men and women of science responsible for the dignity of the medical profession, to guard jealously the principle according to which the true task of medicine is "to cure if possible, always to care".

可以的就治癒，但永遠要照顧

As a pledge and support of this, your authentic humanitarian mission to give comfort and support to your suffering brothers and sisters, I remind you of the words of Jesus: "Amen, I say to you, whatever you did for one of these least brothers of mine, you did for me" (Mt 25: 40).

In this light, I invoke upon you the assistance of him, whom a meaningful saying of the Church Fathers describes as *Christus medicus*, and in entrusting your work to the protection of Mary, Consoler of the sick and Comforter of the dying, I lovingly bestow on all of you a special Apostolic Blessing.

總結



總結

- 意識是基於不同層次的覺醒和覺察
- 人類大腦接收信息並解釋其意義
- 神經連接 (**connectivity**) 對於接收和解釋信息非常重要
- 意識障礙包括昏迷，植物狀態和最小意識狀態
- 對命令的適當反應可能意味著改善,但仍需要仔細的測試來澄清實際情況
- 照顧意識障礙患者，必須盡各種方式保護患者，並且促進康復