

# Out-of-body experience and autoscopy of neurological origin

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# What is autoscapy phenomenon (AP)?

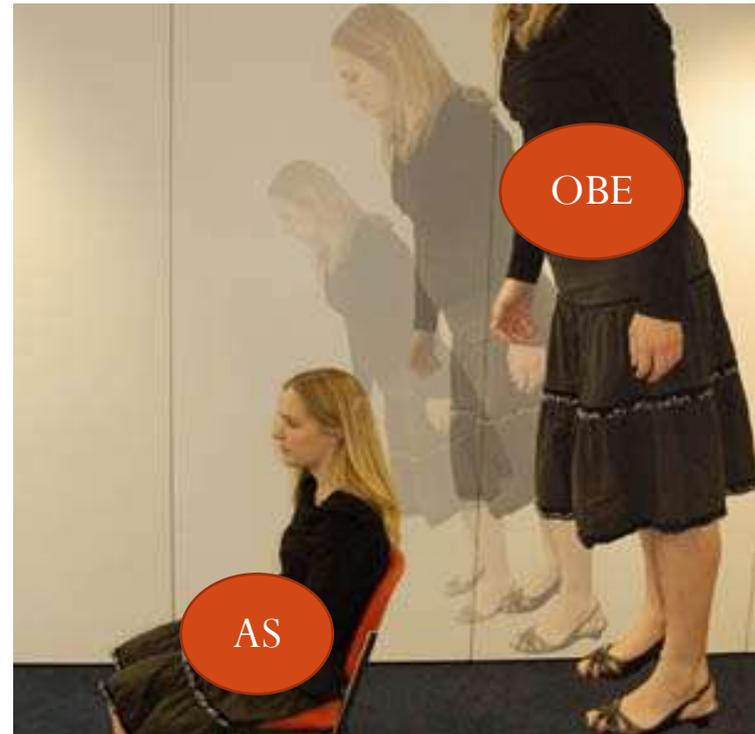
- It is a psychological disorder in which the person sees one's double.

## Autoscopy (AS)

- The experiment seems to see one's body in extrapersonal space but remaining the limits of his physical body.

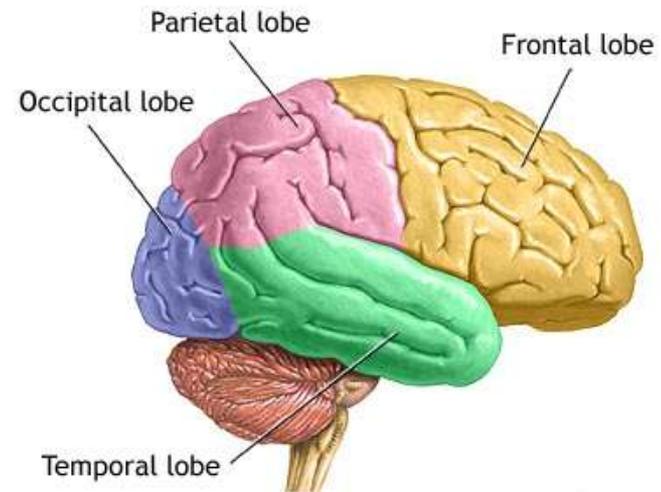
## Out-of-body experience (OBE)

- The experiment appears to see the world and his body from another perspective, out of his physical body.



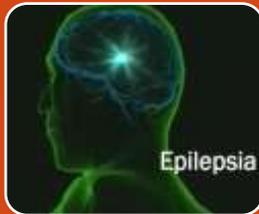
# What is autoscapy phenomenon (AP)?

- Authors argue about the different causes of these phenomenon, but most of them agree that both AP have been related to various neurological and psychiatric diseases like epilepsy, migraine, infarction, schizophrenia, depression.
- There is no widely accepted and testable neuroscientific theory about the central mechanism, but most authors agree about the parietal, temporal and occipital lobes involvement .



# Method: sample

- The sample was constituted by 6 people:



Four of the patients suffered from epileptic seizures and had already experimented AP. Number 1, 2, 5 and 6.



One of the patients suffered from repetitive visual loss and frequent migraine and had already experimented AS. Number 4.



Number three suffered from epileptic seizures but never experimented AP. In this case the OBE was induced artificially by electrical stimulation

# Method:

Semi-structured interview about OBE and AS

- Visual characteristics
- Visual-spatial perspective
- Visual loss
- Another type of hallucination
- Non-visual body-part illusions
- Vestibular manifestations
- Emotional feelings

Electric activity was registered by surface and intracranial EEG and electrical cortical stimulation.

- Long-term video-EEG (1,2 and 6)
- Repetitive EEGs (4 and 5) \*
- Subdural grid recordings (2 and 3) \*

Clinical examination and neuropsychological examination

- Neurological examination \*
- Neuropsychological examination \*

# Method:

## Neuroimaging

- 3D MRI to get information about the structures and the composition of the analyzed object \*
- EEG spike mapping \*
- PET for measuring the metabolic function of the brain \*
- SPECT \*

## Individual lesion analysis

\*

- The neuroimaging for each patient was analyzed detecting lesions and dysfunctions

## Group lesion analysis

- Superposition of the individual neuroimaging to determine the region of overlap overall patients \*

# Clinical Data

**Table 1** Clinical data: results of neurological examination, visual field testing, ictal and interictal surface EEG recordings (sEEG), intracranial EEG (iEEG), 3D MRI, PET, SPECT, neuropsychological examination and individual lesion overlap analysis

Patient (origin)	Neurology	VF	sEEG Ictal/ seizures	sEEG Interictal	iEEG Ictal/ stimulation	MRI	PET Interictal	SPECT Ictal	Neuro-psychology Interictal/post-ictal	OBE/AS Site gyrus
1 (epileptic seizure)	Normal	Normal	R (post T)	-	-	R (O, P, T)	R (O, P)	R (T, O, P)	Topographical agnosia, mental rotation deficit, visuo-spatial memory deficit	AG, LOG, STG, MTG
2 (epileptic seizure)	Normal	Normal	L (post T)	L (T, post T)	L (AG, STG, PCG)	L (post T)	L (T,P)	L (T,P)	Anomic aphasia, verbal fluency deficit, oral and written comprehension deficit	AG, STG, PCG
3 (electrical cortical stimulation)	Normal	Normal	R (T, ant T)	R (T)	R (AG,STG)	Normal	Normal	R (T)	Visuo-spatial and verbal memory deficit, visual agnosia, visuo-spatial fluency	AG, STG
4 (not known)	Left motor loss	-	Normal	Normal	-	Normal	-	-	Normal	-
5 (epileptic seizure)	Spatiotemporal disorientation, right sensori-motor loss	Right lateral homonymous hemianopia	-	L (T, F)	-	L (insula, P, O)	-	-	Global aphasia, apraxia	LOG, AG, insula
6 (epileptic seizure)	Normal*	Normal	L (T)	L (ant T, post T)	-	Bilateral postsurgical subcortical lesions	L (T)	Normal	Naming deficit, ideomotor apraxia, verbal fluency deficit, verbal and visuo-spatial memory deficit	STG, MTG, AG

Anatomical location indicated by: AG = angular gyrus; F = frontal; L = left hemisphere; LOG = lateral occipital gyrus; MTG = middle temporal gyrus; O = occipital; P = parietal; PCG = precentral gyrus; R = right hemisphere; STG = superior temporal gyrus; T = temporal.

# Method: case reports

## Patient 2:

- Complex partial seizures:
  1. He used to hear humming in her right backspace
  2. Sometimes she had the visual impression while lying down that her legs were elevated, bent followed by stretching.
  3. Pharmacoresistant epilepsy
- During presurgical epilepsy evaluation presented an OBE:
  1. The subdural electrodes allowed to localize the seizure onset zone to the angular gyrus in the left hemisphere, overlapping partly with the lesion as defined by MRI \*

\**Complex partial seizures*: Epileptic seizures associated with bilateral cerebral hemisphere and causes impairment of awareness.

# Method: case report

- Prior to operation OBE:
  - She was lying in bed and awakened from sleep. The first thing that she remember was “the feeling of being at the ceiling of the room” She saw herself in bed from above. “There was a man and that she was very frightened” the scene was in colour and realistic.
  - Video revealed facial automatisms and a patient who was on the left
- After operation AS (Focal resection of the middle part of the left superior and middle temporal gyrus and the postcentral):
  - Impression as if she were seeing herself from behind “standing at the foot of my bed and looking down at myself” “I am at both positions at the same time”, without having the feeling of being out of her body.

# General and visual phenomenology of OBE and AS

**Table 2** *General and visual phenomenology of OBE and AS*

Patient	Visuo-spatial perspective		Colour	Visual clarity	Veridicality	Integration of actual facts	Presence of other seen objects/subjects
	Number	Position					
1 (OBE)	1	Para	+	High	+	-	+
2a (OBE)	1	Para	+	High	+	+	+
2b (AS)	2	Para/Phy	-	Medium	+	+	+
3 (OBE)	1	Para	+	High	+	+	+
4 (AS)	2	Para/Phy	+	High	+	+	+
5 (AS)	2	Para/Phy	+	High	+	+	+
6 (AS)	1	Phy	-	High	-	(+)	(+)

The number and position of the visuo-spatial perspective (para = parasomatic; phy = physical), the presence of coloured vision (+ = yes; - = no), the visual clarity (high, medium, low) and veridicality of the experience are given (+ = yes; - = no). In addition, the integration of actual facts into the experience (+ = yes; - = no) and the presence of other seen objects/persons than the patient's own body (+ = yes; - = no) are given.

# Results

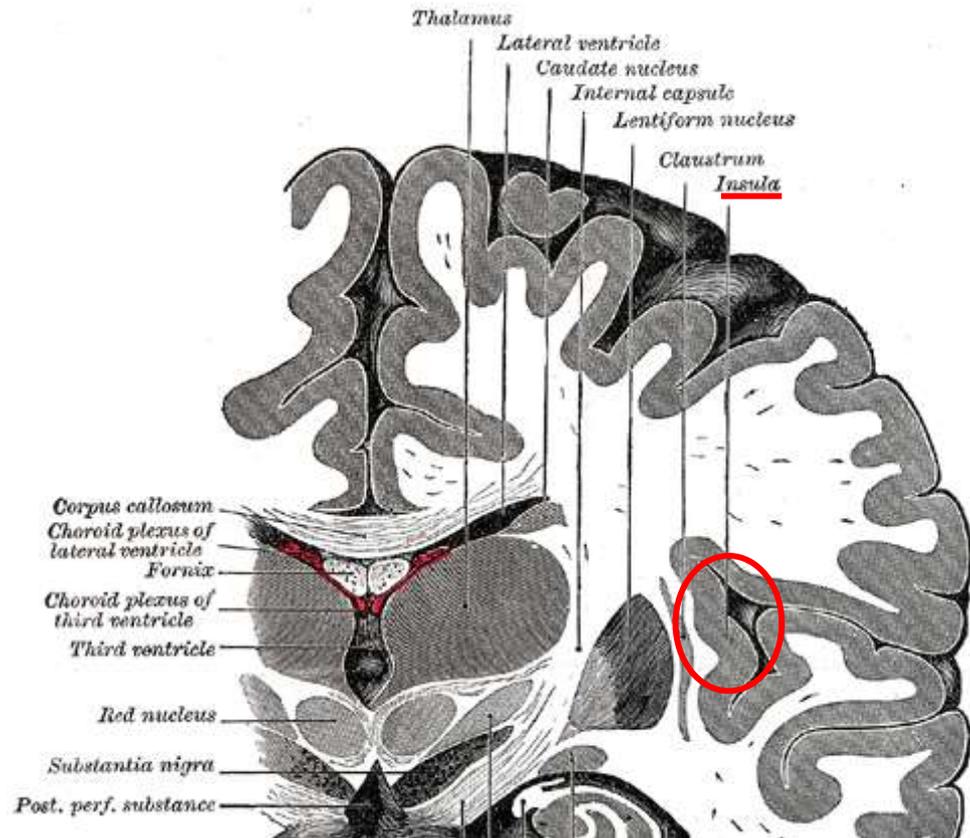
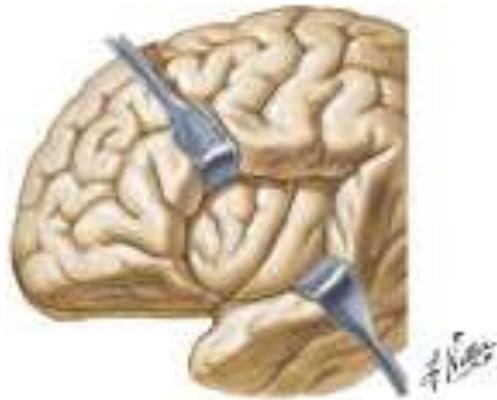
	<b>OBE</b>	<b>AS</b>	<b>OBE &amp; AS</b>
Visual phenomenology	<ul style="list-style-type: none"> <li>-One only perspective from the parasomatic body</li> <li>-Elevation and inverted by 180°</li> <li>- Prior position was lying</li> </ul>	<ul style="list-style-type: none"> <li>-More than one simultaneous visio-spatial perspective</li> <li>-Prior position was standing or sitting</li> </ul>	<ul style="list-style-type: none"> <li>-Vivid and veridical</li> <li>-The patient's own body was among other objects</li> <li>- Immediate self-recognition</li> </ul>
Non-visual phenomenology	<p>Vestibular sensations were floating and flying but not rotating.</p>	<p>More variable vestibular sensations</p>	<ul style="list-style-type: none"> <li>-The sensations were most vestibular</li> <li>-Some experienced body part illusions</li> <li>- Most of the reported emotions were fear</li> </ul>

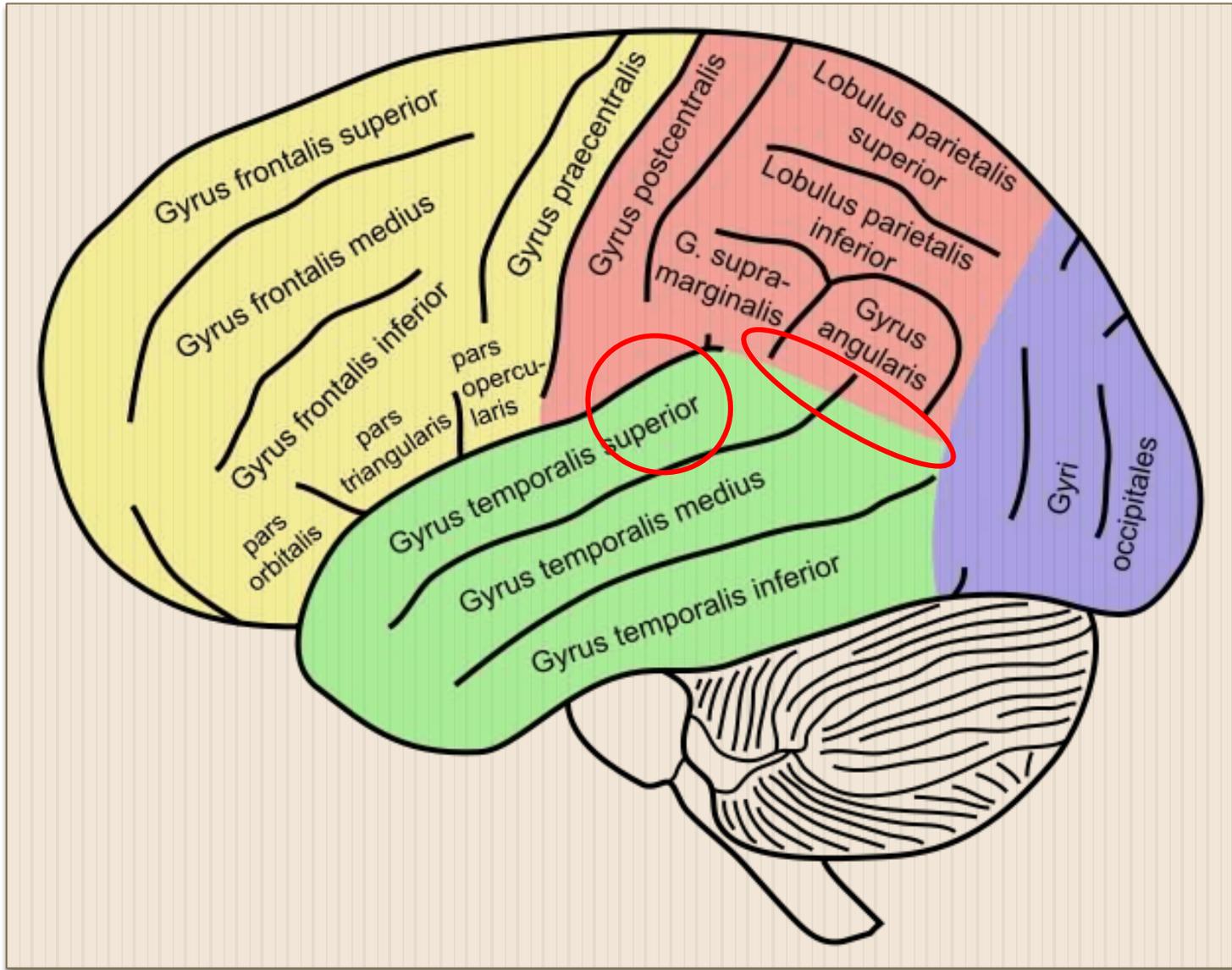
# Results

	OBE	AS	OBE & AS
Impairment of consciousness (no ability to respond or remember)			<ul style="list-style-type: none"> <li>-It was partial related to complex partial seizures.</li> <li>-Patient 3 showed no impairment of consciousness</li> </ul>
Neuropsychology	<ul style="list-style-type: none"> <li>-83% showed specific language and visuo-spatial deficits</li> <li>-50% showed memory deficits</li> <li>-17% executive deficits</li> </ul>		
Anatomy	<ul style="list-style-type: none"> <li>-Both hemispheres are involved</li> <li>-The angular gyrus are involved in all 5 patients in whom lesions analysis could be performed.</li> <li>-The mean lesions of the patients was centered on the temporo-parietal junction (TPJ) including the anterior part of the angular gyrus and the posterior part of the supèrior temporal gyrus.</li> </ul>		

# Discussion: vestibular dysfunction

- OBE and AS: frequent associations with vestibular sensations and mechanisms (rotating, floating, flying,...) Implication of the vestibular cortex situated at the TPJ and/or posterior insula.



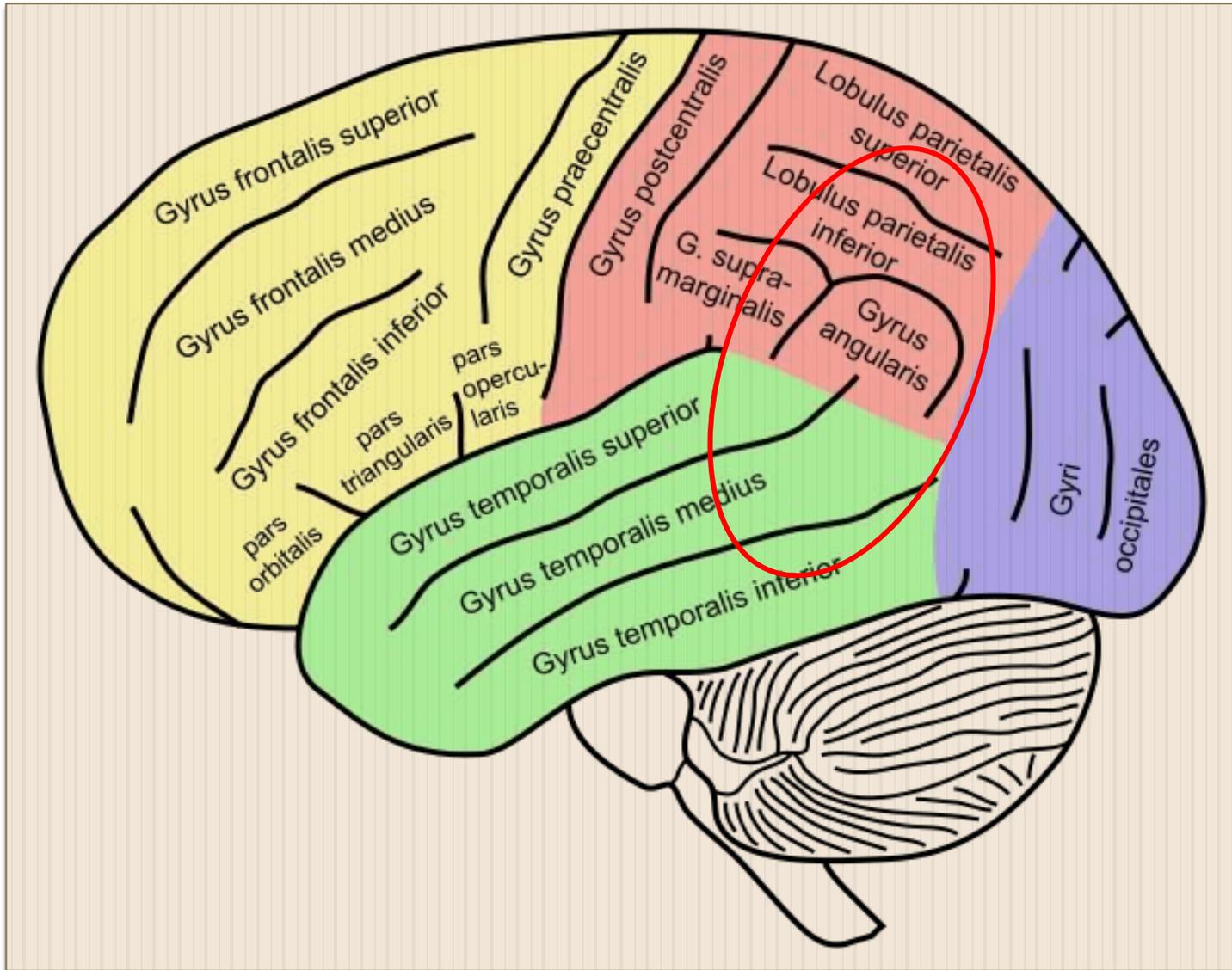


# Discussion: vestibular dysfunction

- Usually, the TPJ is activated when the perspective changes, it process the gravity sensation, equilibrium,... by the testimony of the patients we can affirm a dysfunction at this zone.
- A vestibular dysfunction might be necessary but not a sufficient condition to induce AP

# Discussion: information integration

- There is a failure in integrating proprioceptive, tactile and visual body-related information in a coherent central representations of one's body.
  1. Visual body-part illusions
  2. The patient's own body seen during the autoscopic phenomenon was often restricted. (only upper or lower body)
  3. The AP differ depending of the patient's position suggesting an influence of proprioceptive and tactil mechanisms.
- The TPJ and/or cortical areas near are implicated in combining tactile, proprioceptive and visual information
- The patients who showed body-part illusions had a dysfunction in posterior parietal lobe or in posterior temporal lobe.



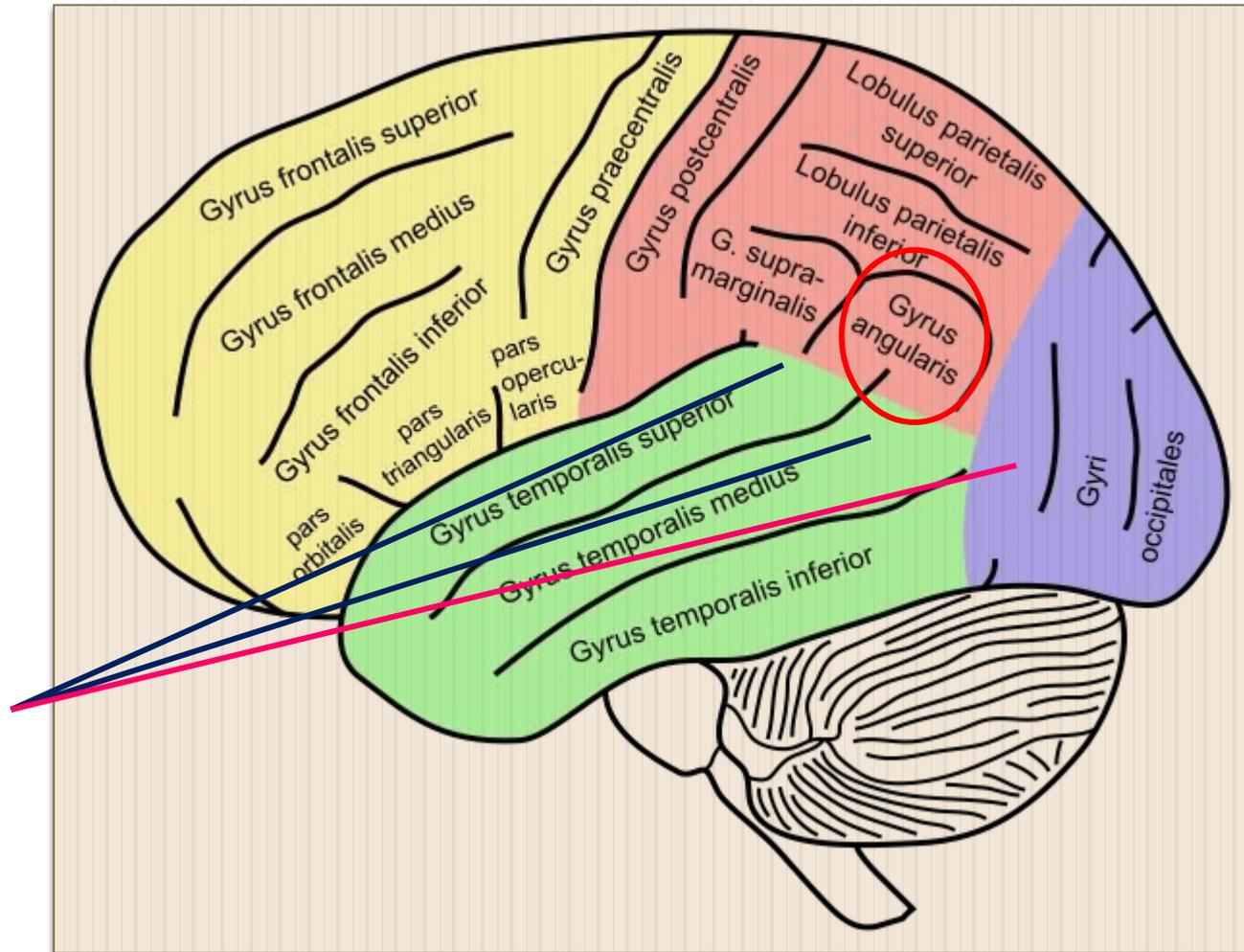
# Take home message

- The AP phenomenon is mainly caused by PTJ dysfunction.
- The different forms of AP are related to different degrees of vestibular dysfunction
- A failure of information integration lead to additional disintegration between personal (vestibular) space and extrapersonal (visual) space.
- We can conclude that AP phenomenon has nothing to do with parapsychological phenomenon. Everything is in our brains!

A close-up photograph of a hand holding a white ceramic cup. The hand is positioned on the right side of the frame, with the thumb and index finger gripping the rim of the cup. The cup is on the left side of the frame. The background is dark and out of focus. The text "Vielen dank für eure Aufmerksamkeit!" is overlaid in the center of the image.

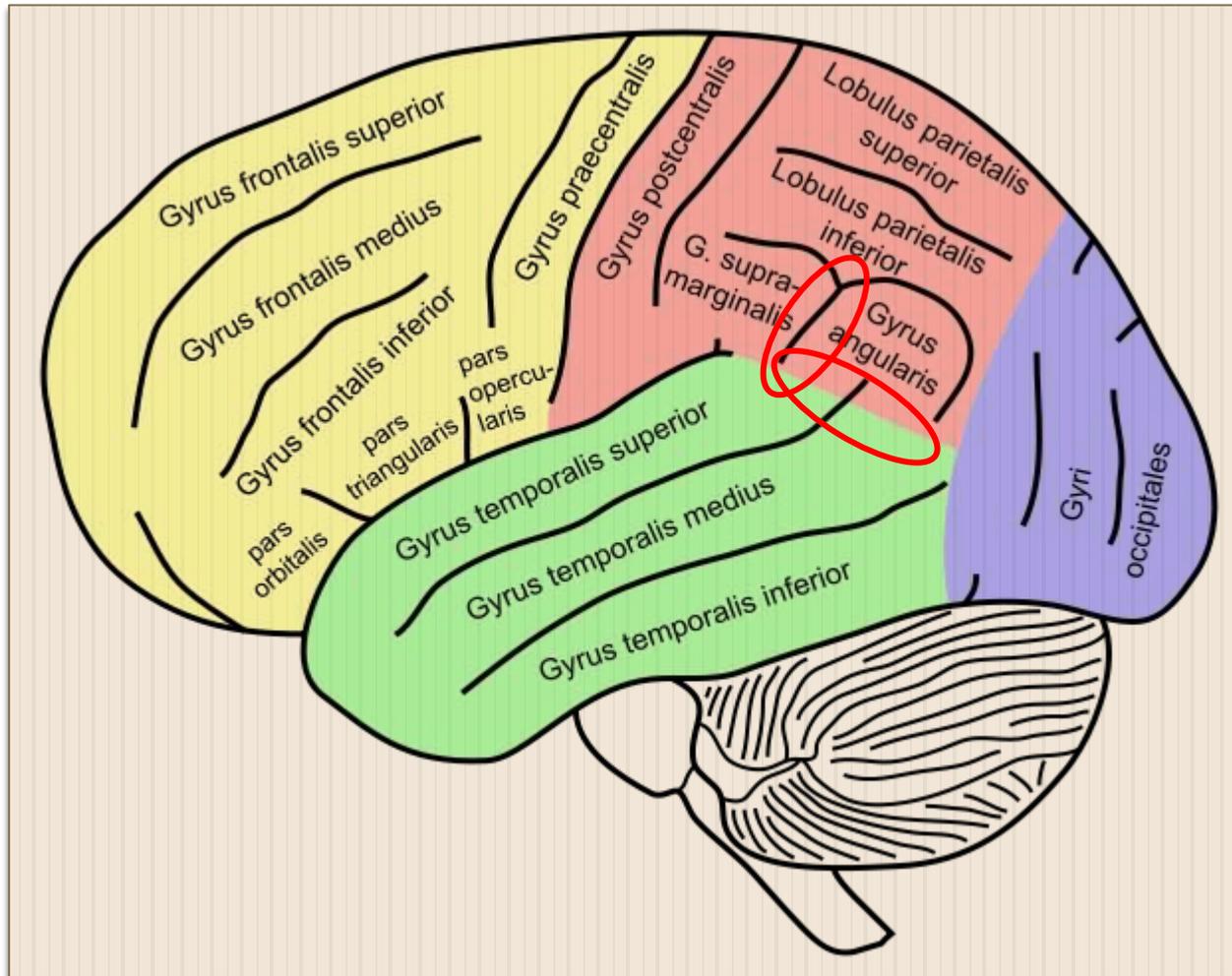
**Vielen dank für eure Aufmerksamkeit!**

# Results: the perform of the angular gyrus

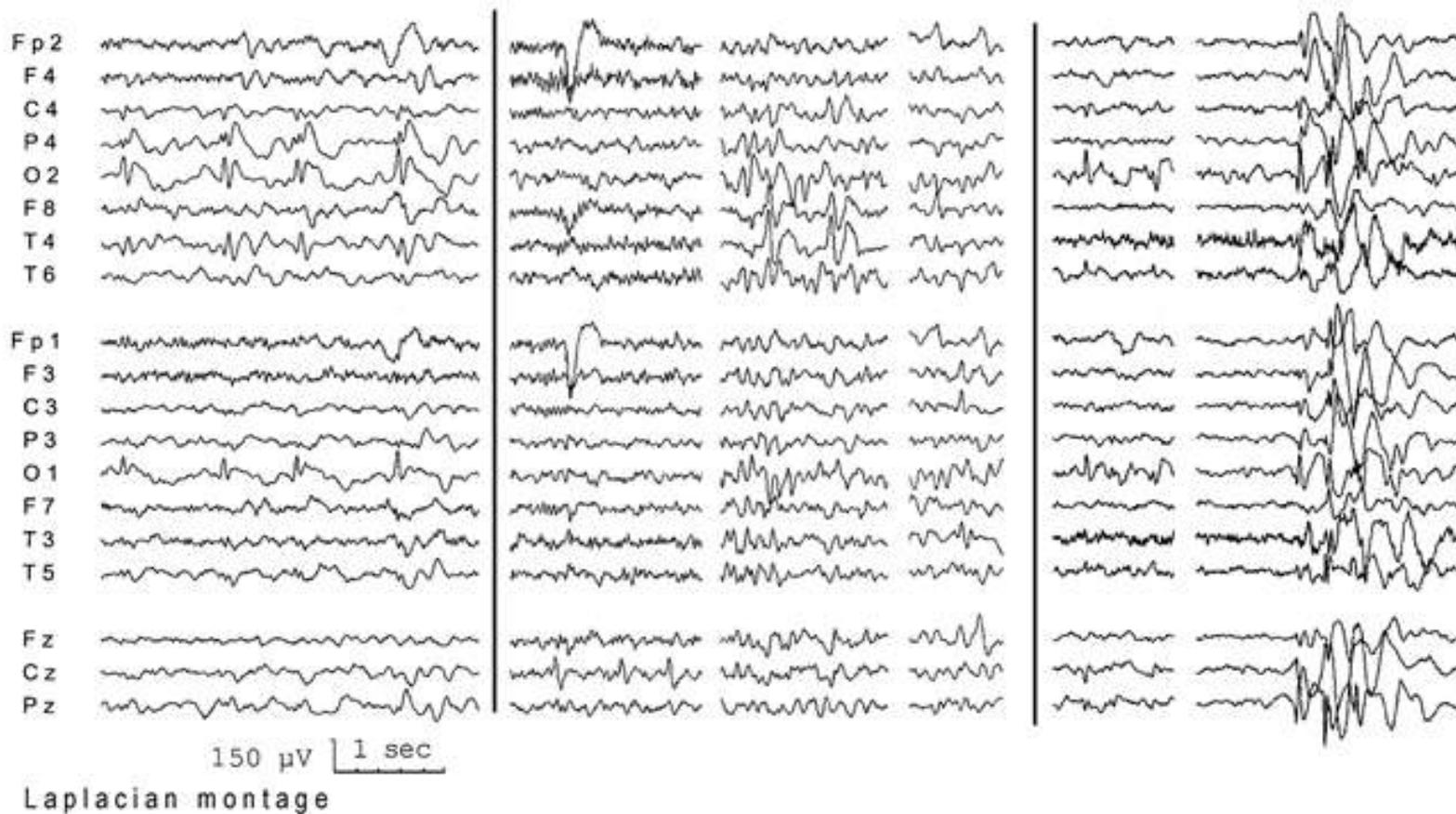


Two patients

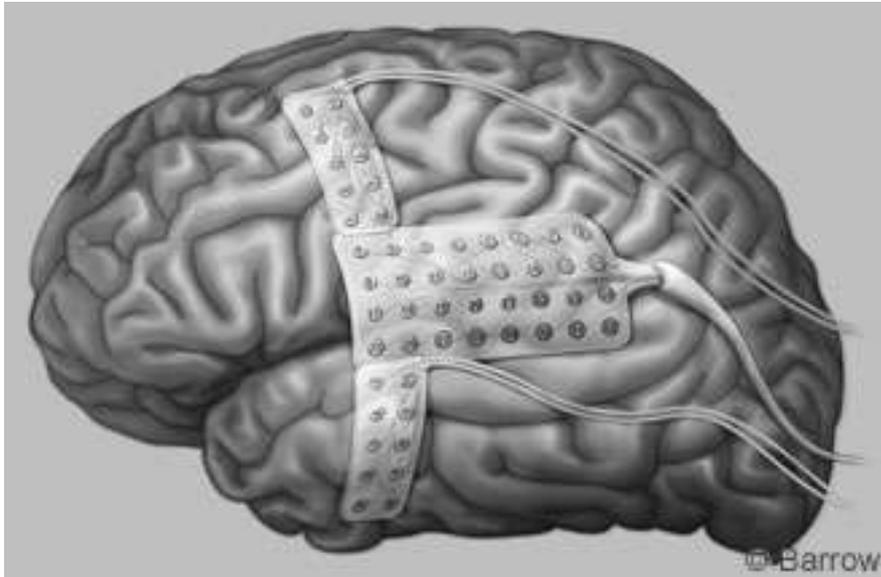
# Results: Mean lesions TPJ



# Repetitive EEGs



# Subdural grid recordings



# Neurological examination



Cranial Nerves



Motor examination

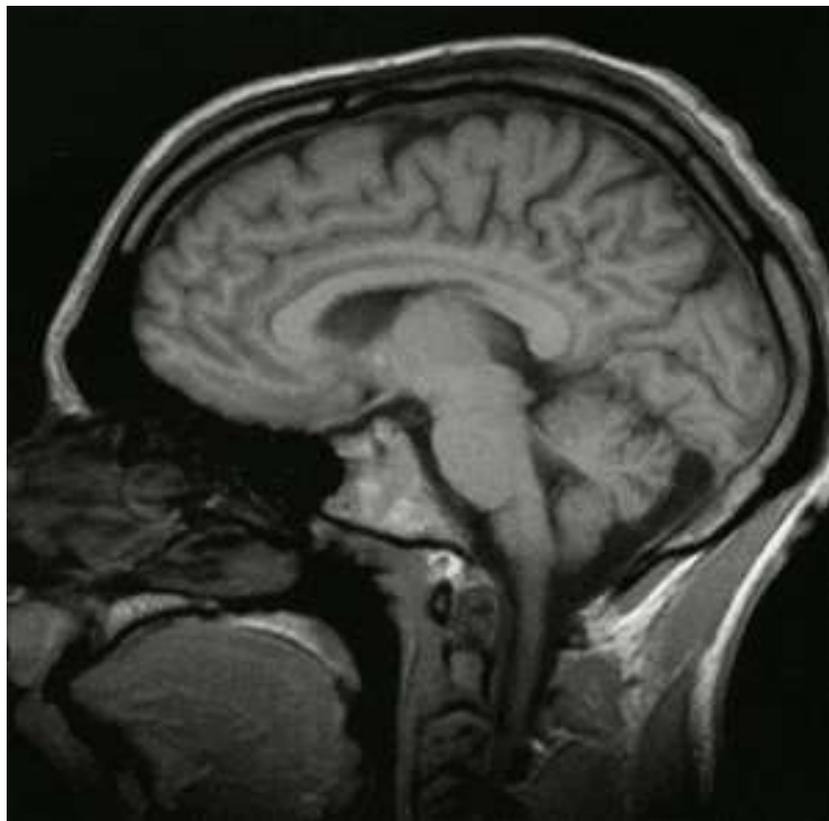


Sensory examination

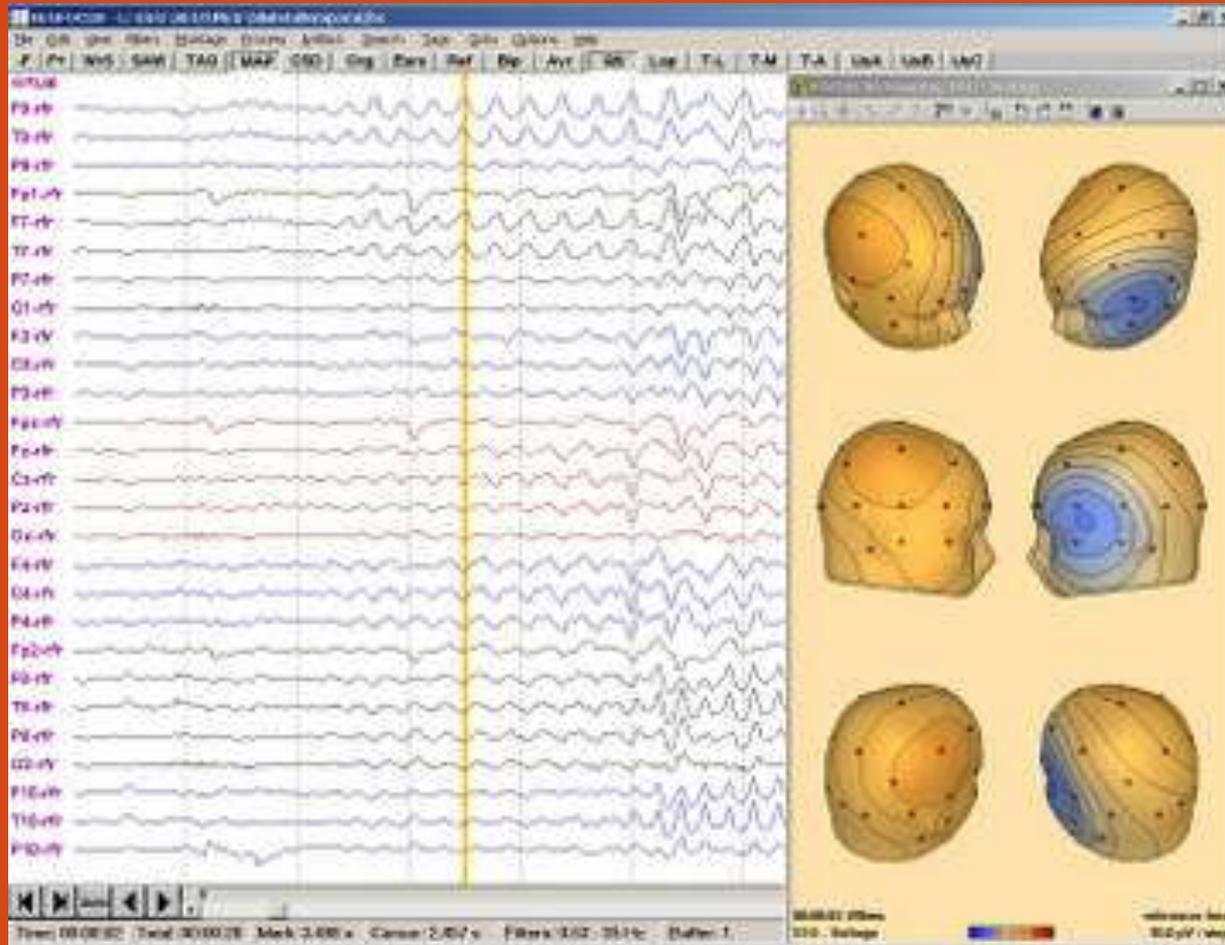
# Neuropsychological examination

- Measure psychological functions:
  - Memory
  - Abstract thinking
  - Executive functioning
  - Judgment
  - Language
  - ...

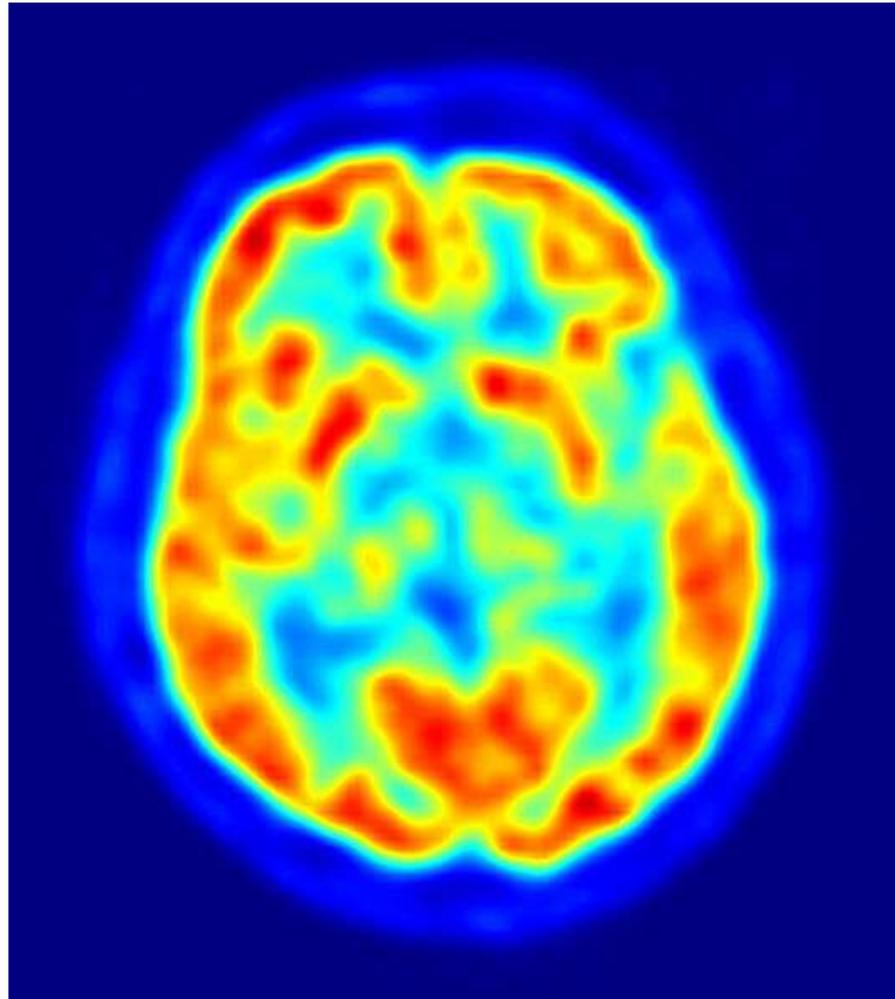
# MRI



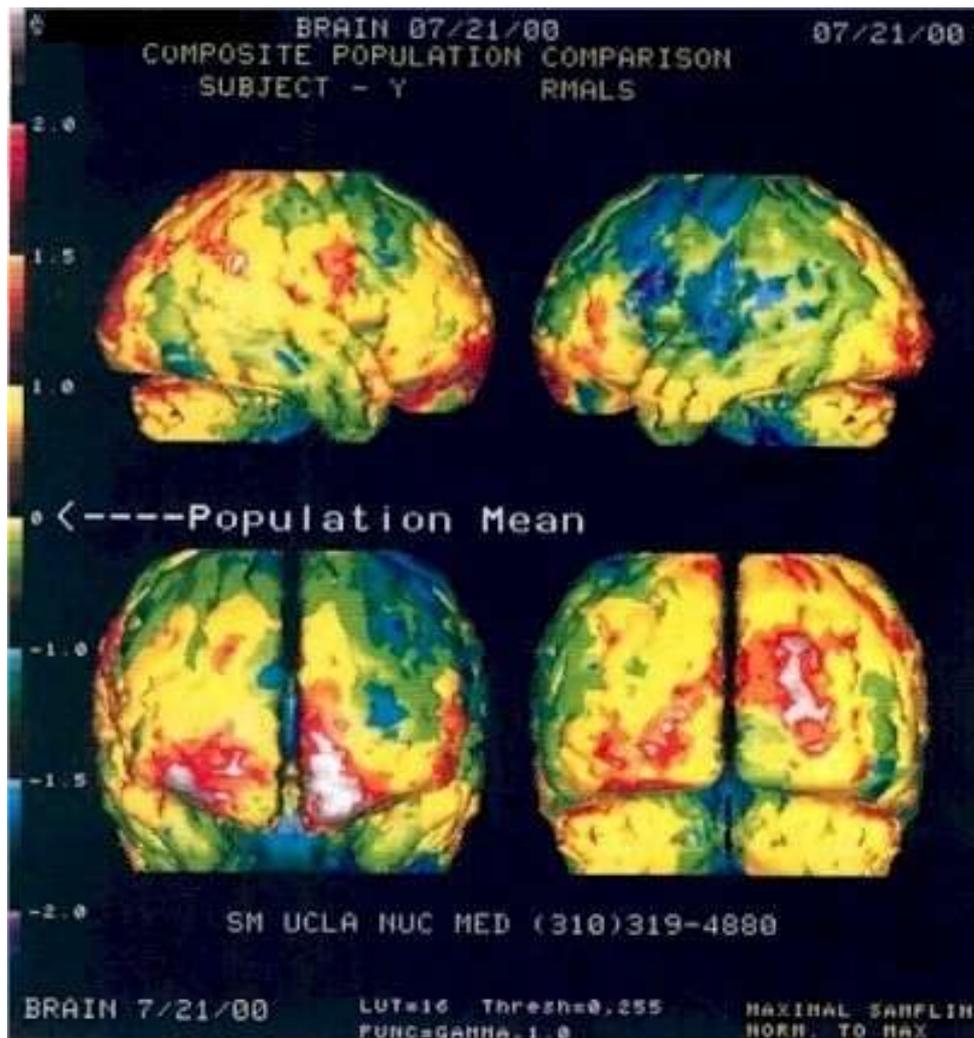
# EEG spike mapping



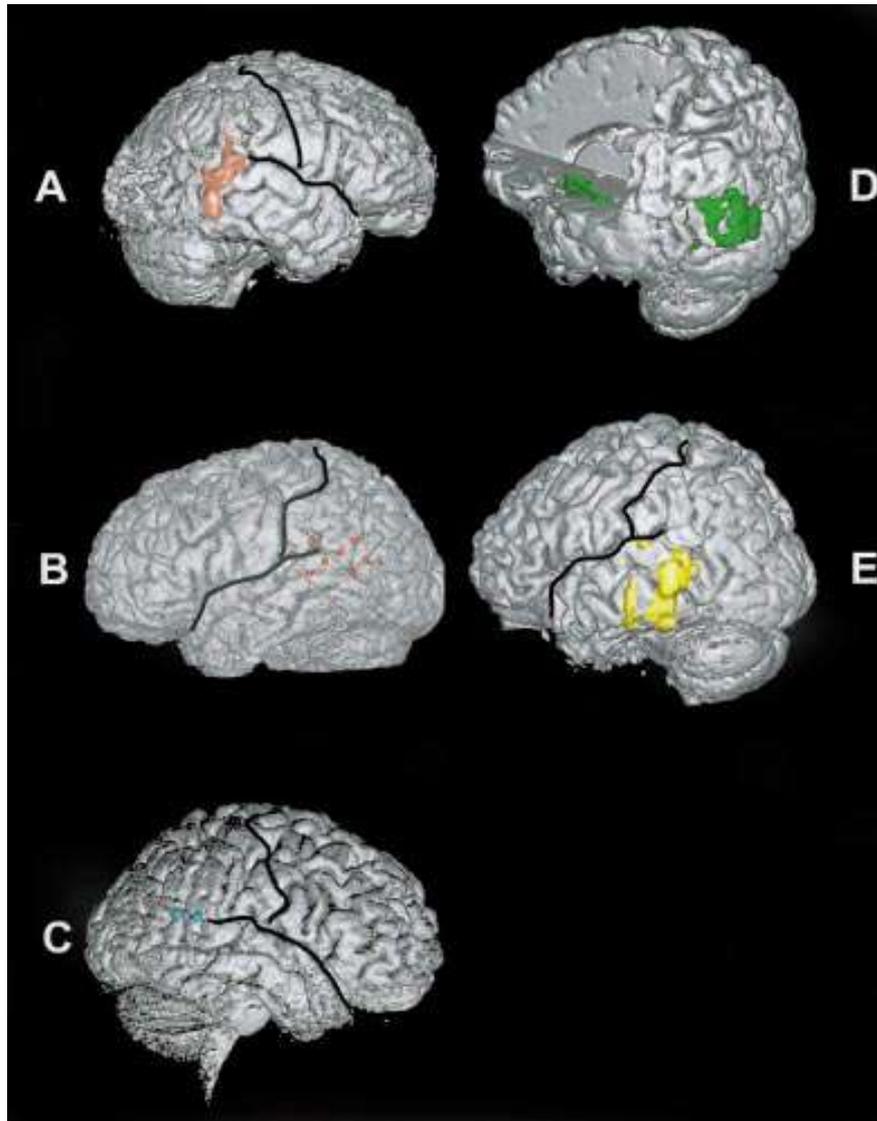
PET



# SPECT



# Individual lesion analysis



# Mean lesion overlap analysis

