

# **An Overview of TBI for the Non-Neuropsychologist**

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# A brain is a vulnerable organ

Approximately 3 pounds or 1,400 grams;

Einstein's brain weighed 1,230 grams;

2% of total body weight;

25% of total body oxygen consumption;

30% of total body glucose utilization;

78% water;

Consistency of tofu;

100 billion neurons;

170,000 km of axons.

# Dinner at *Angelo's*

Pasta primavera with Chianti;

A deer waiting on Rt. 9;

Ambulance ride;

Hospital, surgery;

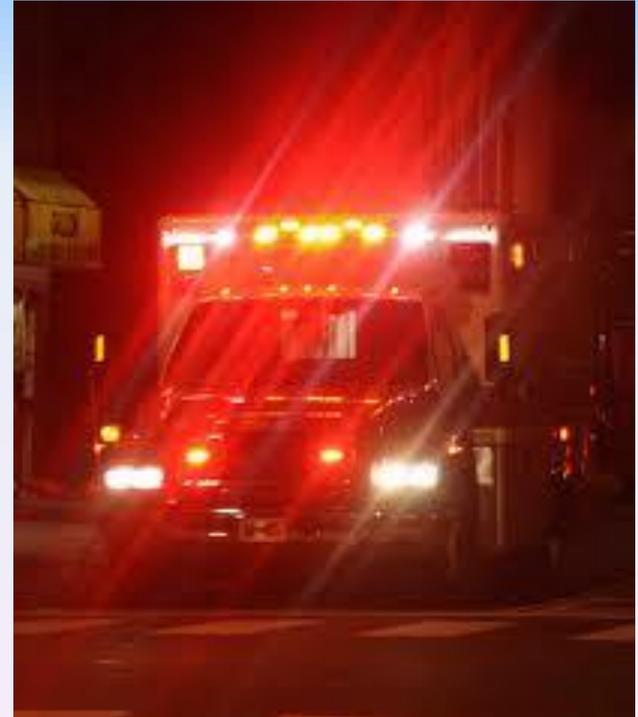
Acute rehab, subacute rehab;

Work, school problems;

Family problems;

Insurance, financial, legal problems;

Medical, psychological, existential problems.



# Have you ever hit your head?

Head injury may be a presenting condition or it may be completely ignored or forgotten.

Have you ever had a concussion?

Been in an accident?

Blacked out? Passed out?

Lost consciousness?

Had a sports injury?

Should have had a V8?



# Brain injury vs. disease

## No clear boundaries

- Congenital/Genetic (MR);
- Developmental/Maturational Problems (arguably includes LD and ADD);
- Progressive Degenerative Dementias (e.g., Alzheimer's, Pick's, Lewy Body, Guillain-Barre syndrome);
- Vascular Dementias;
- Seizure Disorders;
- Infections.



# Causes of brain injury

- **Traumatic (TBI)**
  - **Vascular**
    - **Anoxic/Hypoxic**
      - **Toxic/metabolic**
        - **Tumors**
          - **Infection**
            - **Iatrogenic**

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Various studies show that TBI incidence rates range from 92 to 618 per 100,000;

Approx 42,000 - 75,000 people die from acute TBI each year in the U.S.;

Approx 2 million traumatic head injuries occur per year in the U.S.;

56% of adults had a positive BAC during TBI;

TBI high-risk groups are: men, ages 15-24 and >64, non-whites, lowest SES;

Estimated direct and indirect cost of TBI in the U.S. is approx \$50 billion per year;

# Causes of brain injury

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TBI severity (Mild, Moderate, Severe) is defined by many markers, including:

Length of LOC;

Presence of Anterograde or Retreograde Amnesia;

Brain imaging;

Neurologic findings;

Glasgow Coma Scale (max 15 points);

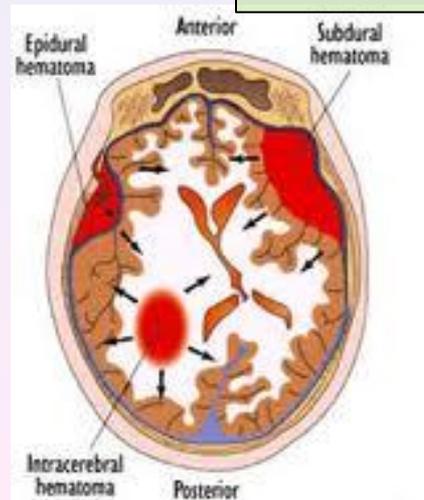
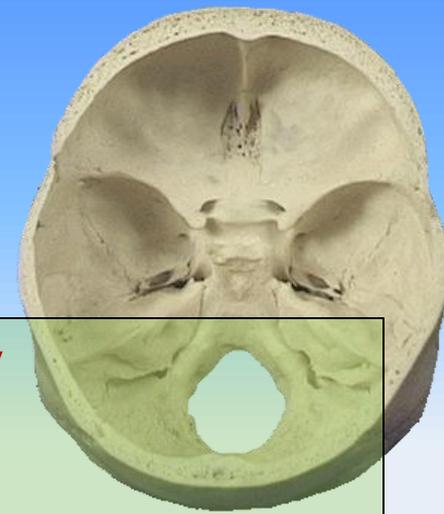
Post-TBI symptoms;

Rancho Los Amigos Cognitive Functioning Levels (VIII levels).

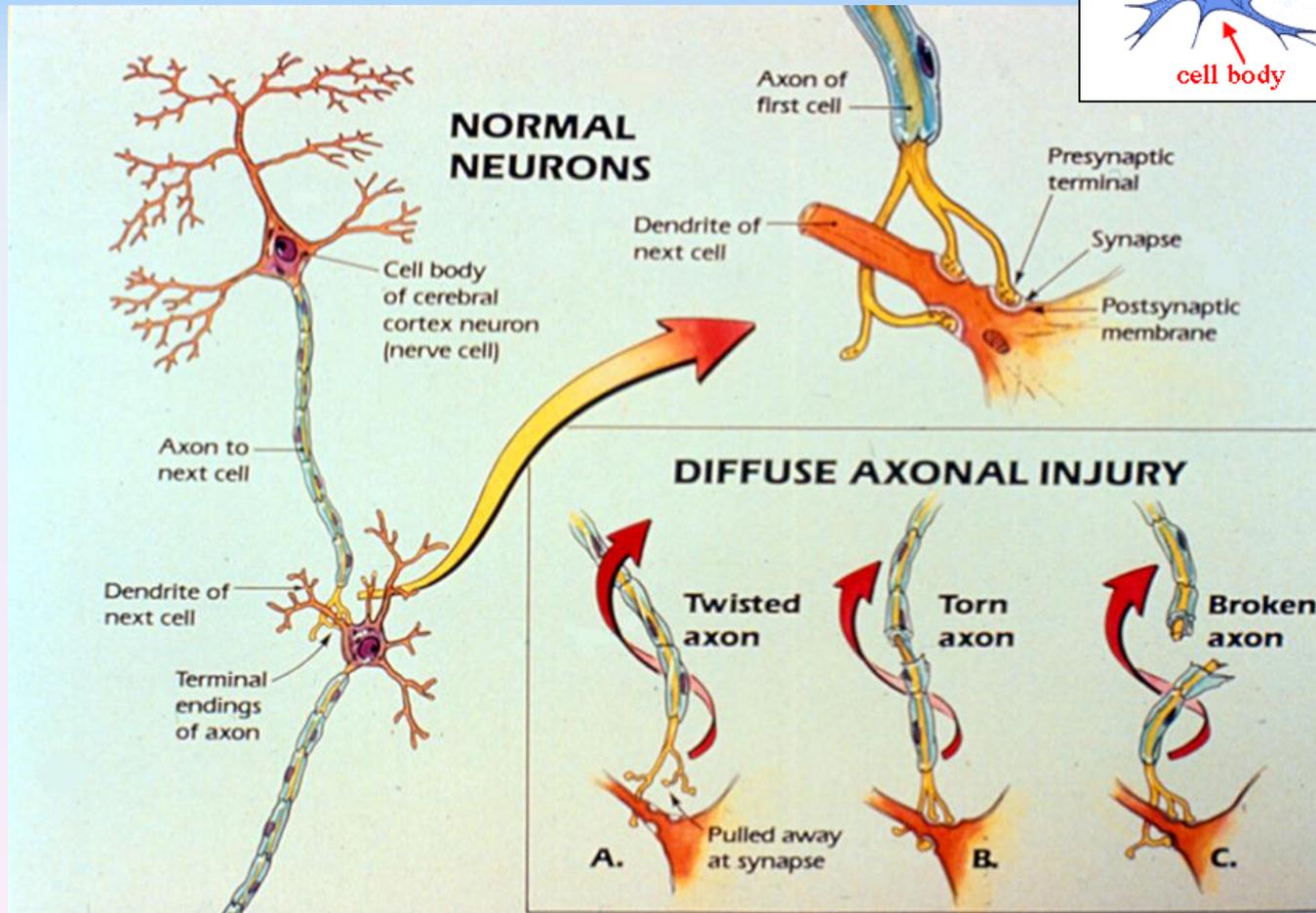
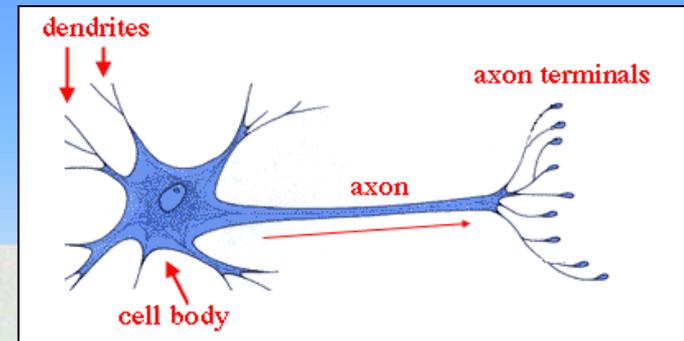
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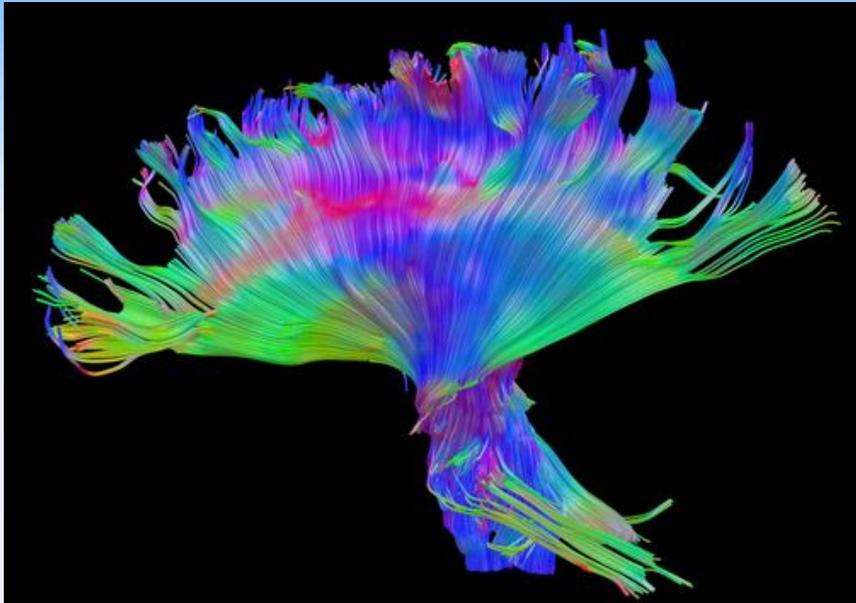
Open vs closed head injury  
Coup-contrecoup injury  
Acceleration-deceleration injury  
Blast injury  
Diffuse axonal injury  
Excitotoxic neuronal injury cascades



# Diffuse axonal injury

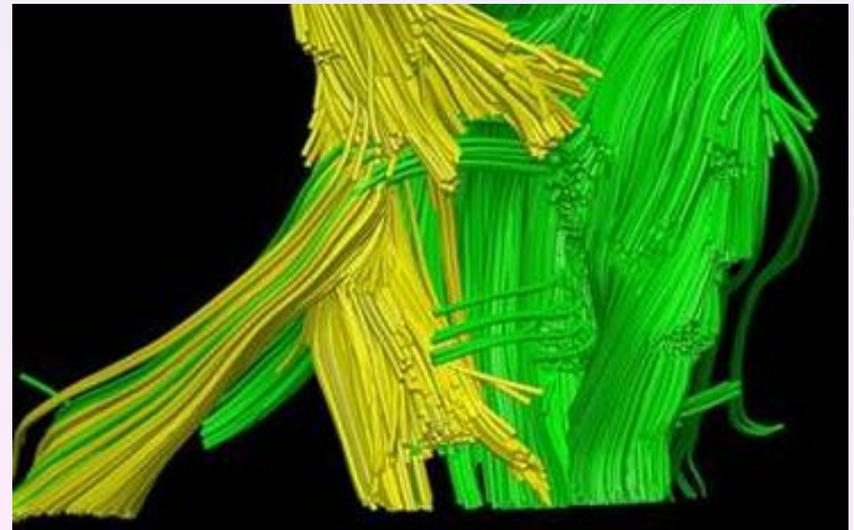


# White matter (axonal) connections



Brain connections visualized using ***Diffusion Tensor Imaging (DTI) Tractography***.

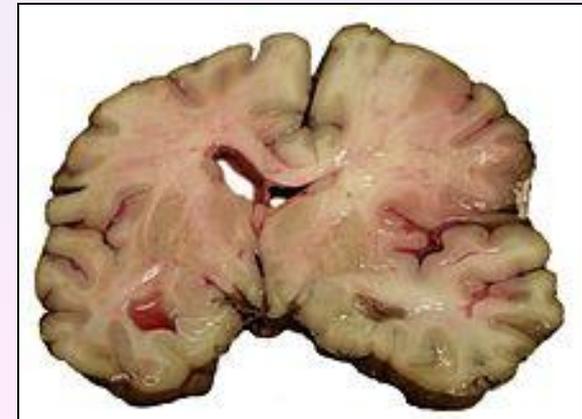
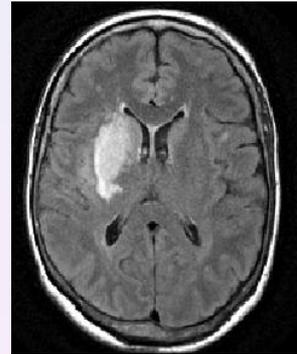
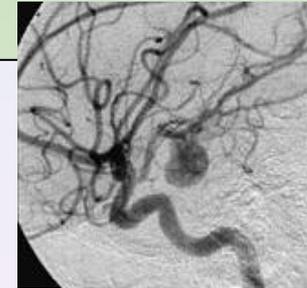
High resolution (2-3 Tesla) MRI, Diffusion-Tensor Imaging, Gradient Echo MRI, Tractography or MEG are more sensitive, BUT more expensive and less available.



# Causes of brain injury

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CVA (cerebrovascular accident);  
Ischemic stroke (thrombosis, embolism);  
Hemorrhagic stroke;  
Aneurysm;



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Drowning, strangulation, MI, CO, heroin, cocaine & rattle snakes.

Some areas of the brain are especially vulnerable to hypoxia or ischemia:

upper brainstem (reticular activ. format.), cerebellum, white matter, hippocampus, neocortex.

Complications:

DOC, VS, MCS, seizures, myoclonus;

Movement disorders (delayed mo, yrs);

Sympathetic (autonomic) storming;

Cognitive impairments;

Sensorimotor impairments.

# Causes of brain injury

- Traumatic (TBI)
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Toxins (lead, mercury, arsenic, pesticides, industrial solvents, etc.);

Alcohol;

Illicit drugs;

Metabolic byproducts of kidney and liver disease;

# Causes of brain injury

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Originating inside the skull  
(meningiomas, astrocytomas,  
glioblastomas, etc.)

Metastatic tumors

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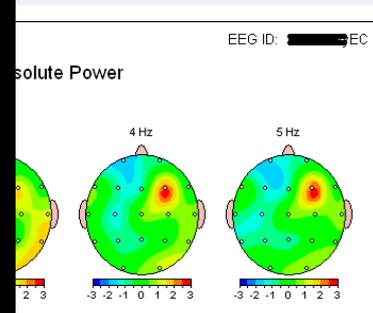
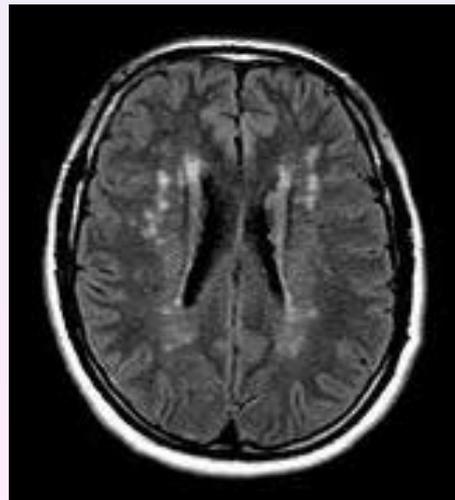
Viral and bacterial meningitis and encephalitis

Lyme disease

West Nile virus

Jakob-Creutzfeldt disease

Brain abscess



# Causes of brain injury

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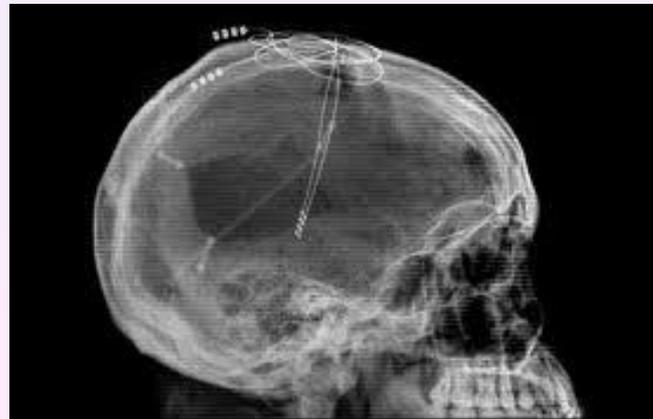
Surgery

DBS

ECT

Radiation

Medications (e.g., tardive dyskinesia, extrapyramidal symptoms, neuroleptic malignant syndrome, serotonin syndrome)



# Impairments of consciousness

What is consciousness? Awareness?

Many definitions. Here is one: *“Consciousness is the capacity to have and the having of an experience of any kind.”*

Disorders of Consciousness (DOC):

Coma,

Vegetative State,

Minimally Conscious State.

A highly political/ideological issue.



# TBI symptom checklist

## Cognitive

Attention

Short-term memory

Processing speed

Executive functioning

Thinking processes

Lack of awareness

## Emotional

Mood swings

Depression

Hypomania

Anxiety

Anger

Apathy

Impulsivity

Disinhibition

Sexual inappropriateness

“Personality change”

## Physical

Fatigue

Sleep disturbance

Headache

Weight change

Visual problems

Balance problems

Dizziness

Seizures

Spasticity

Loss of urinary control

Loss of libido

# Agnosia

Lack of awareness of disability (vs. denial);

Anosognosia;

May include paralysis, blindness, deafness, cognitive deficits, etc.;

Unilateral (usually visual) neglect;

*Capgras* and *Cotard* delusions;

Difficult to treat;

Indicator of poor prognosis.



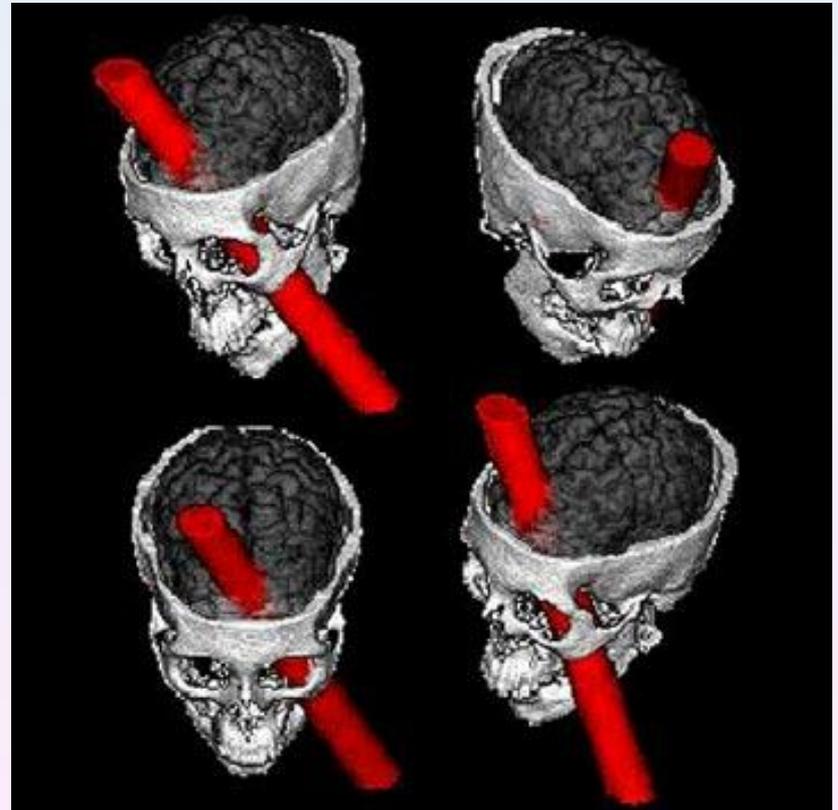
# Phineas Gage



This 19<sup>th</sup> century railroad worker lost a large chunk of his forebrain when a steel rod was blown through his skull.

He underwent a dramatic personality change – from “purposeful and industrious worker” into a “drunken drifter.”

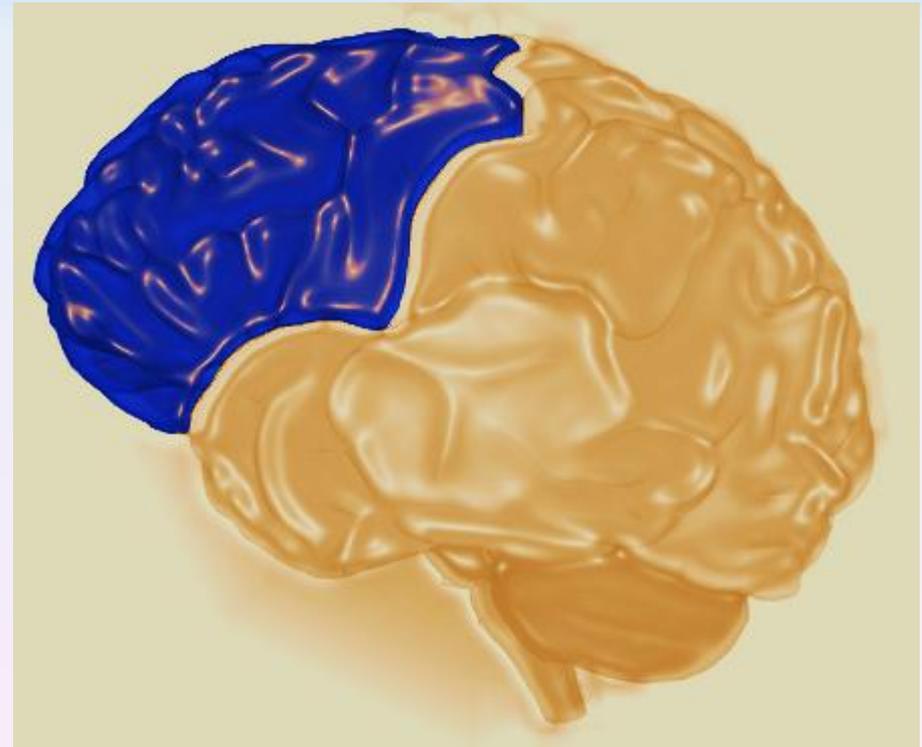
This classic case of Frontal Lobe injury spurred interest in what was used to be called the Silent Lobes.



# Frontal lobes

The frontal lobes are involved in “higher” cognitive functions

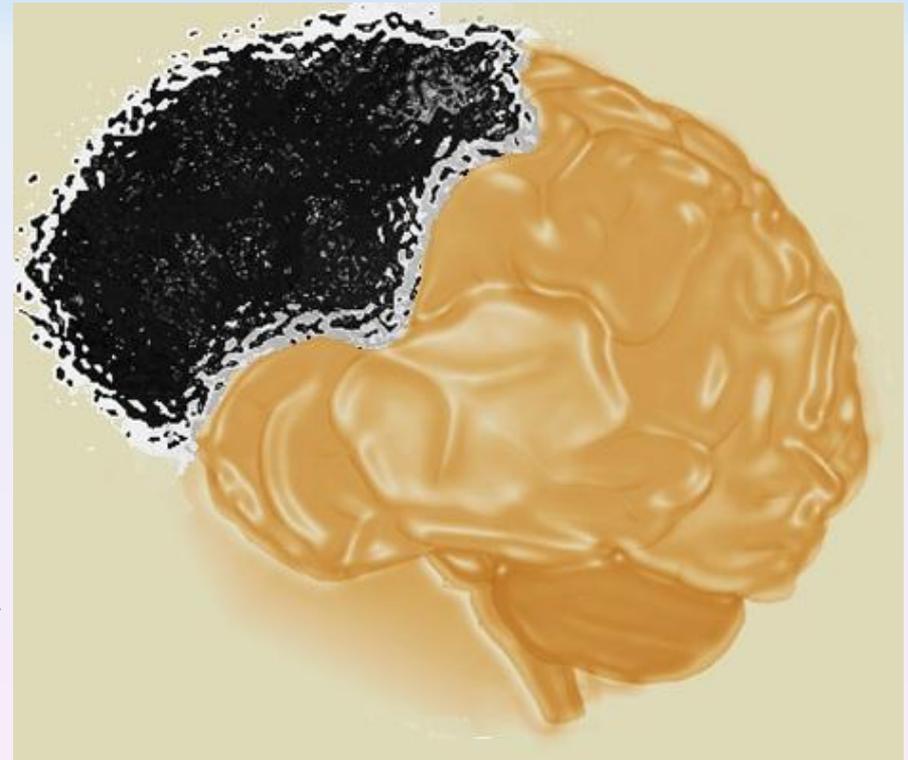
- Executive functions
- Spontaneity
- Mental effort & goal pursuit
- Working memory
- Foresight & planning
- Sequencing
- Motivation & will
- Judgment
- Impulse control
- Sustained attention
- Supervisory attentional system
- Metacognition
- Complex social behavior
- Emotional regulation
- Understanding humor & metaphors
- Awareness of others



# Frontal lobes

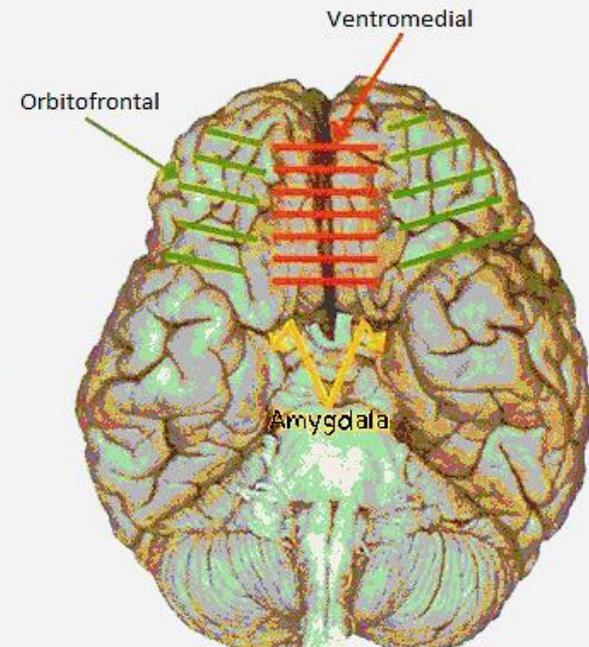
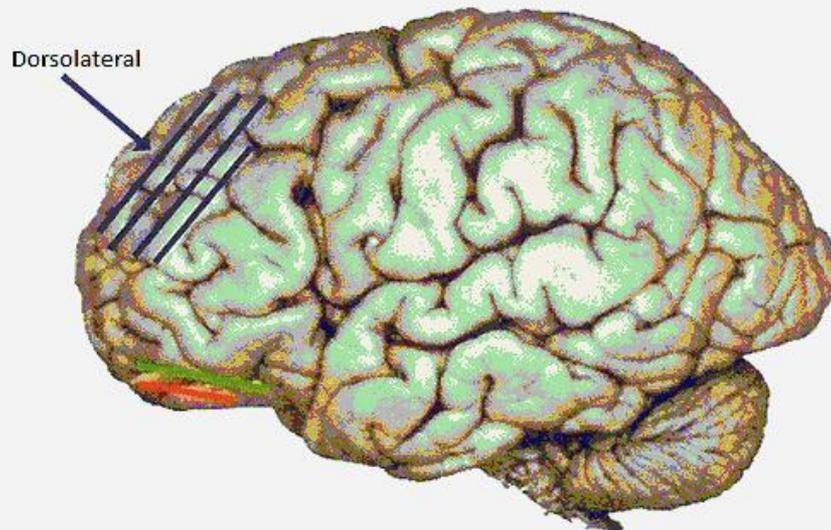
Injury to the frontal cortex leads to

- Impulsivity
- Disinhibition
- Apathy, lack of motivation
- Attention problems
- Difficulty planning
- Disorder of sequencing
- Perseverative behavior
- Difficulty shifting mental sets
- Poor judgment
- Emotional deregulation
- Problems with short-term memory
- Decreased will, drive & energy
- Diminished creativity
- Diminished understanding of humor
- Lack of social sensitivity
- Lack of foresight, but not necessarily insight



# Frontal lobe deregulation syndromes

- Dorsolateral Syndrome, a.k.a. “Pseudodepression”  
(apathy, abulia, lack of drive and initiation, perseveration, rigid thinking)
- Orbitofrontal Syndrome, a.k.a. “Pseudopsychopathic syndrome”  
(disinhibition, impulsivity, recklessness, aggression, jocularity, “tipsy adolescents”)



# Neuropsychological testing

Assessment of attention, memory, verbal skills, visual-spatial perceptual skills, executive functioning, intelligence, speed of processing, manual dexterity, etc.;

Scope and extent of the testing;

Effort, motivation, malingering;

Exaggeration & minimization (not always conscious);

Context of the testing (IME, forensic, nocebo effects).

# Comorbidity

## TBI

- ↓ Processing speed
- ↓ Mental energy
- ↓ Organization skills
- ↓ Impulse control
- ↓ Judgment
- ↓ Memory

Pain

## Leads to

- Frustration
- Feeling overwhelmed
- Depression
- ↑ Risk of alcoh abuse

## PTSD

- Hyperarousal
- Hypervigilance
- Avoidance
- Numbing
- Detachment
- Social isolation

## Leads to

- Alcoh/subst use:
  - Self-medicate
  - Relieve Anxiety
  - Avoid memories
  - Socialize

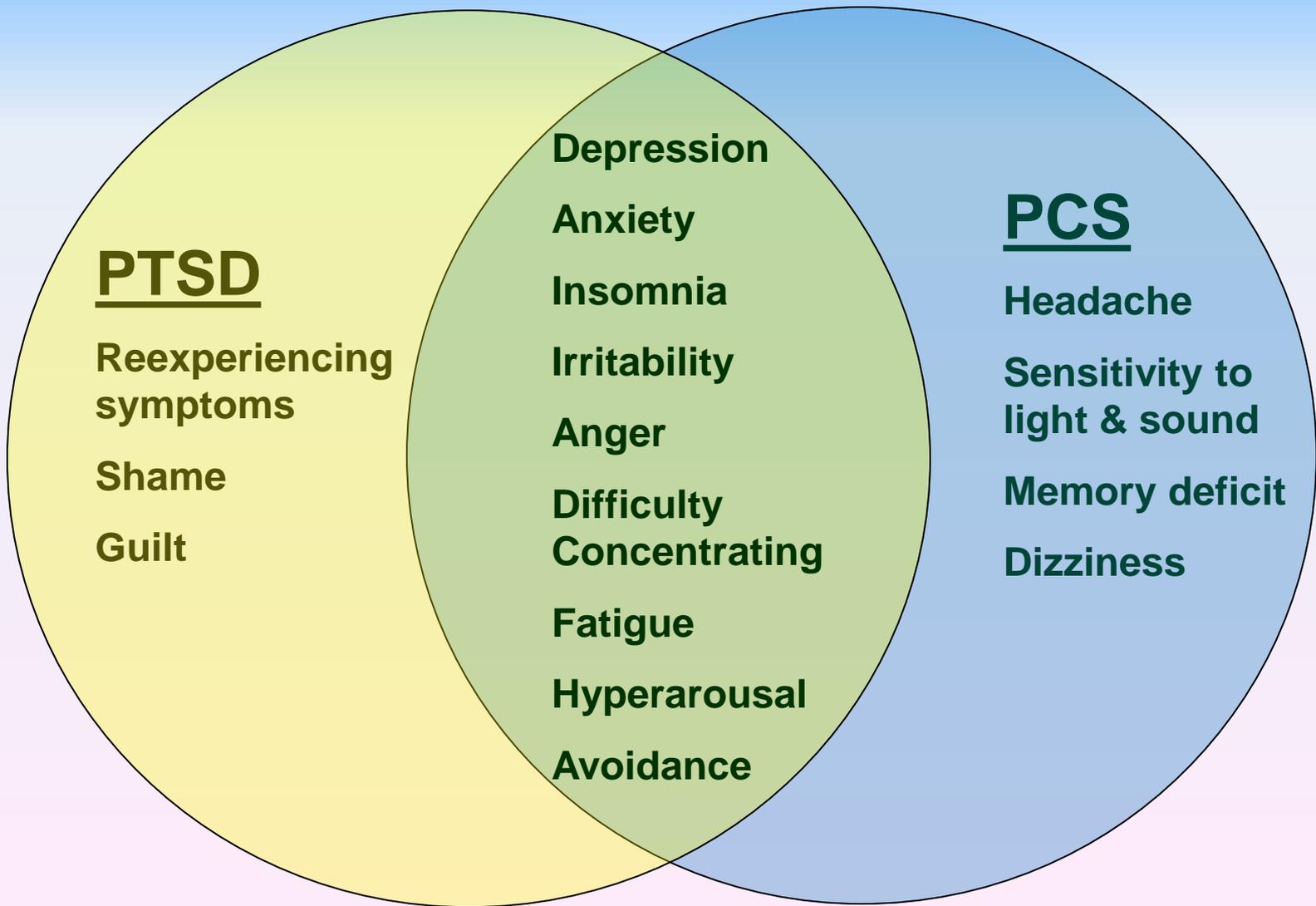
## Alcoholism

- Compulsive use
- ↑ Tolerance & use
- ↓ Impulse control
- ↓ Judgment
- Withdrawal
- Failed efforts to control
- Increased time using

## Leads to

- Cognitive impairment
- Emotional deregulation
- Social isolation
- Psychiatric comorbidity
- ↑ Risk of TBI

# Interface of PTSD and post-concussive symptoms



# Illness as a learned behavior

Underdiagnosing and overdiagnosing TBI;

9 out of 10 patients with fibromyalgia or depression meet criteria for post-concussive disorder (in absence of TBI);

Somatoform disorder, fibromyalgia, pain disorder, psychophysiological insomnia, neuro-Lyme, etc.;

## ICD-10 criteria for Post-Concussion Syndrome;

Hx of head trauma with LOC and 3 or more symptom categories:

- Headache, dizziness, malaise, fatigue, noise intolerance
- Irritability, depression, anxiety, emotional lability
- Subjective memory, concentration or intellectual difficulties
- Insomnia
- Reduced alcohol tolerance
- Preoccupation with above symptoms and fear of brain damage with hypochondriacal concern and adoption of sick role.

# Functional vs. organic

A false dichotomy: analysis should not be based on the “mind-body dualism” – it’s not that simple.

Often patients may have functional elements to “real” organic conditions and organic conditions often serve as a nidus for development of functional conditions.

Studies suggest that there are likely both biomedical and psychosocial correlates to non-organic behavior (e.g., somatoform and conversion disorders).

The boundary between non-organic and organic impairment grays daily.

“WE SEE WHAT WE LOOK FOR,  
WE LOOK FOR WHAT WE KNOW”

*GOETHE*

# BI treatment

Importance of case management;

Medical & restorative therapies (PT, OT, Speech, etc.);

Pharmacotherapy;

Cognitive therapies;

Psychotherapy;

Behavioral therapies;

“Alternative” therapies.

Social, vocational, family, ethical, legal issues.

# Treatment: pharmacotherapy

There are no FDA-approved treatments for post-traumatic cognitive impairments;

All medication uses are “off-label”;

Medical studies, empiric trials & anecdotal cases have demonstrated limited efficacy of some cognotropic medications, including: amantadine, bromocriptine, carbidopa, methylphenidate, donepezil, physostigmine & rivastigmine;

Many more medical trials are underway.

# Cognitive & behavioral Tx

Restoration and compensation models;

Cognitive remediation;

Computer programs (e.g., Lumosity, BrainTrain, etc.);

Errorless learning;

Cognitive “prosthetics”;

Importance of the contexts;

Environmental antecedents;

Importance of timing and scheduling;

# Psychotherapy

Issues of awareness (the shrinking universe);

Pre-injury mental health, co-morbidity;

Social capital, role crisis;

Emotional deregulation;

Marital/family problems;

Financial problems;

Self-esteem problems;

Sexuality problems;

Legal & insurance problems;

Social stigma, guilt, false expectations;

Medication, substance and alcohol abuse.

# Alternative therapies

Compounds with neurologic benefits:

- Cholinergic enhancers (galantamine, huperzine, citicholine, centrophenoxine, acetyl-carnitine);
- Nutrients (S-AMe, picamilon, pyritinol);
- Herbals (ginkgo biloba, vinpocetine, ginseng);
- Nootropics (piracetam, L-deprenyl, B vitamins);
- Homeopathy;

Neurofeedback, LENS;

Hyperbaric oxygen therapy;

# The End

Thank you!

(take good care of your brains!)

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