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Disorders of Behavioural Self-Regulation:

after Traumatic Brain Injury.

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Bwrdd Iechyd Prifysgol Abertawe Bro Morgannwg University Health Board

Content of Presentation

1) Neurobiology of emotional recognition and expression.
2) Impact of traumatic brain injury on self-regulated social behaviour and emotion-awareness.
3) Disorders of emotion recognition.
4) Developmental implications.
5) Aggressive disorders in relation to poor emotion self-regulation.
6) Treatment approaches

Emotion

"The principle currency underpinning human relationships".
"The motivational force for the best and worst of human behaviour".

R Dolan

Emotion, Cognition, and Behaviour.

Science, 2002. 8(298),1191-1194.

Friedrich Nietzsche

Understanding emotion in others means that you can share other people's experiences.

"If we don't learn how our actions and judgements affect others, we will never learn to appreciate other people's needs and feelings".

SOCIAL COGNITION

(the domain of neuroscience)

'Theory of Mind' (ToM)

Neurobiological Basis of Emotional Regulation.

Key structures in the regulation and expression of emotion

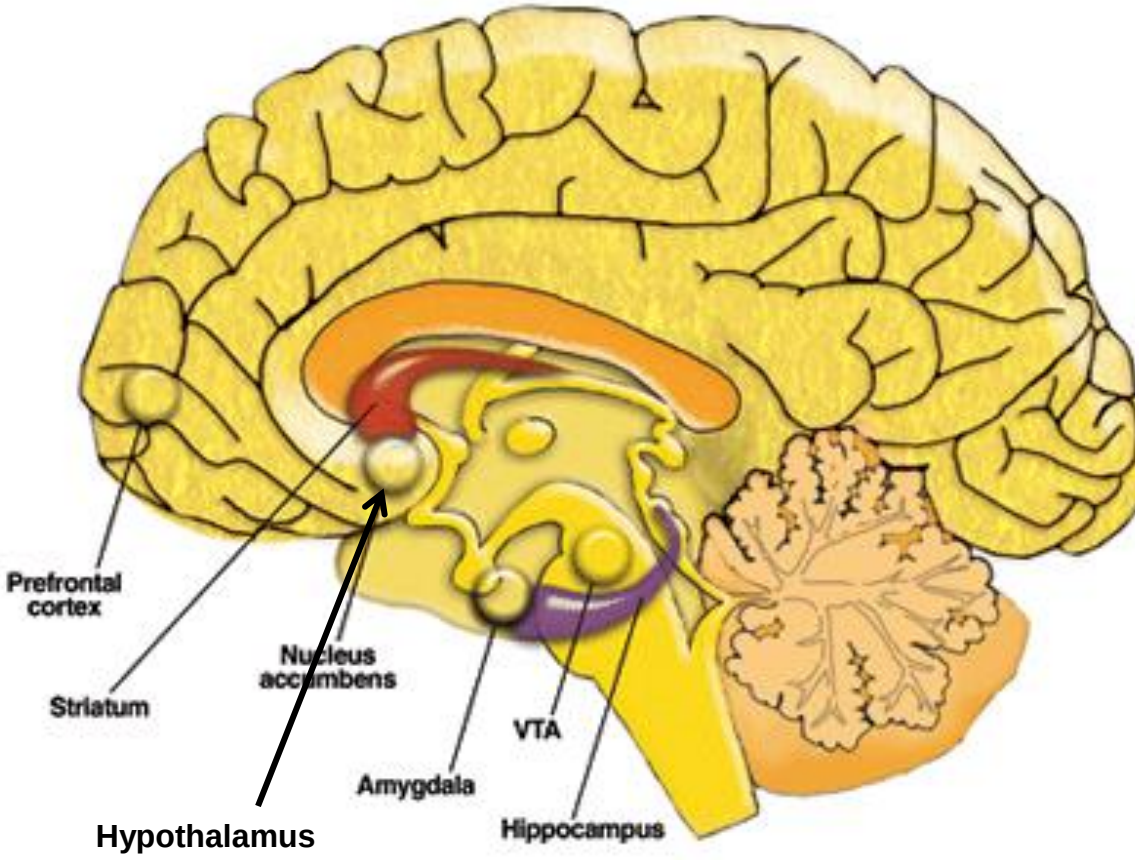
Davidson et al (2000), Science, 289, 591-594

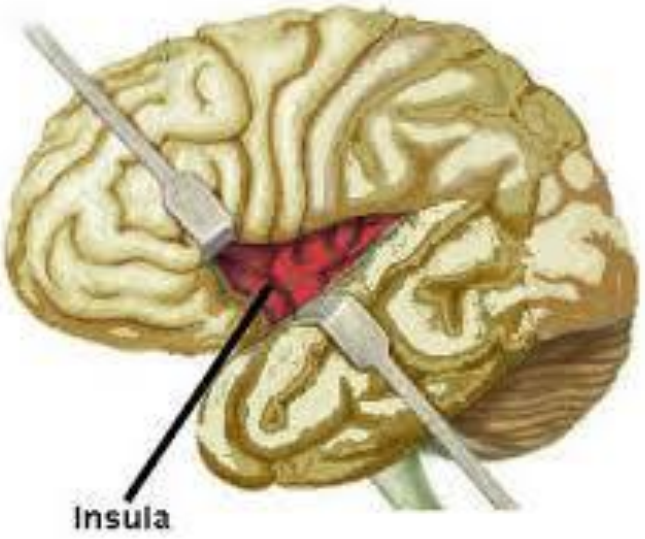
Emotional regulation relies on a complex circuit:-

orbito-frontal cortex
anterior cingulate
ventral striatum
hypothalamus
hippocampus
amygdala
insular.

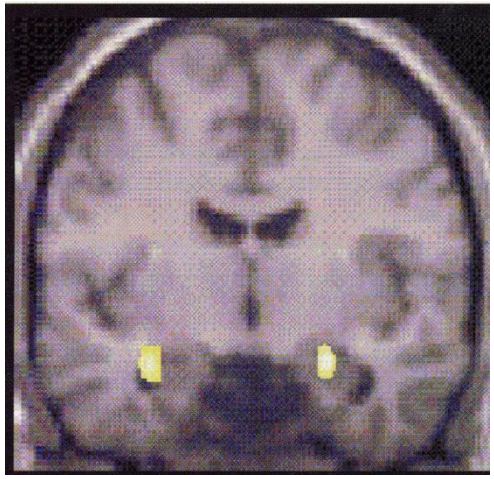
Communication between structures largely mediated by serotonin

Anatomical Geography



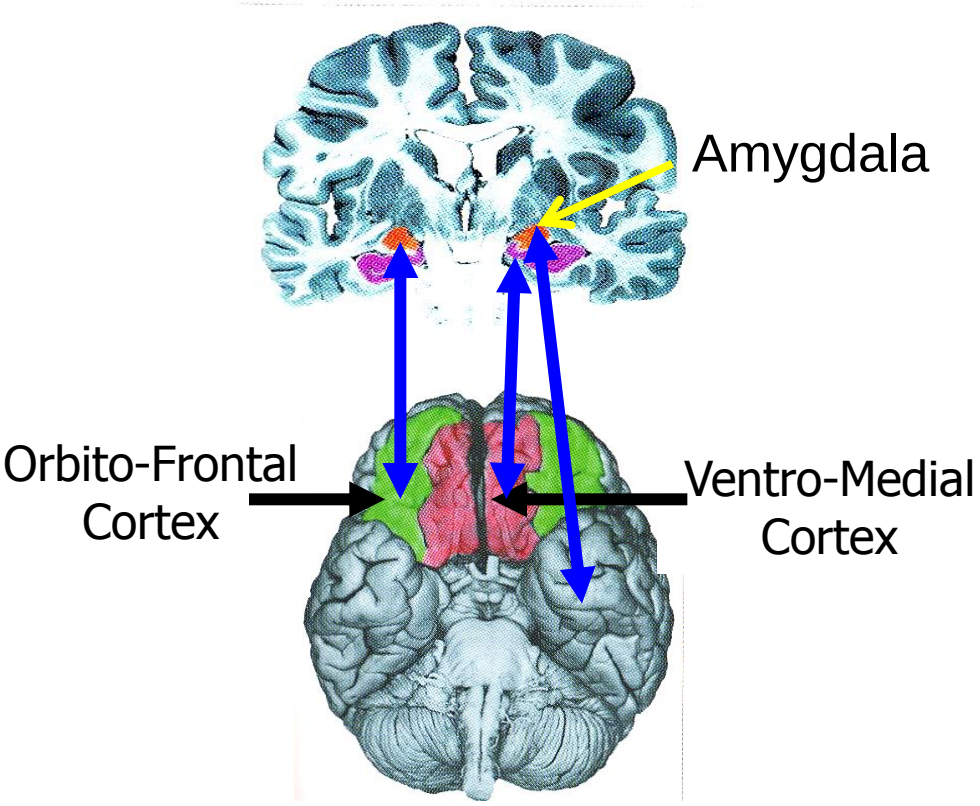


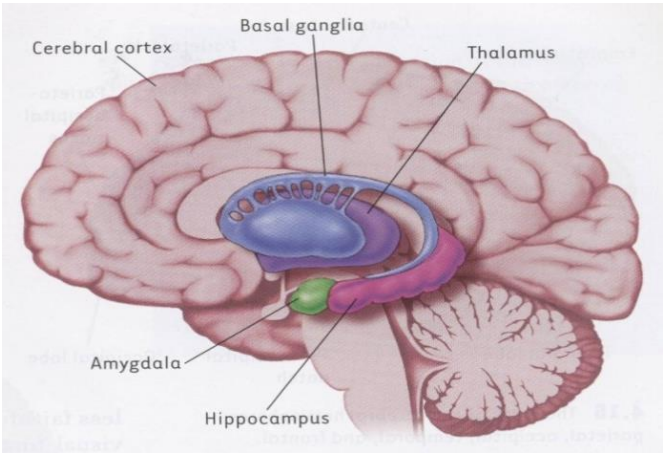
Amygdala and Social Cognition.



- Social cognition often relies on being able to recognize peoples emotions from facial expression.
- Functional neuro-imaging shows that the amygdala controls our ability to recognise facial emotional expressions.
- Amygdala activity greatest when confronted with negative emotional stimuli, such as expressions of anger or fear.
- Perceptions of anger or fear in others can elicit an emotional reaction in the observer.

Amygdala
Emotion Perception & Expression

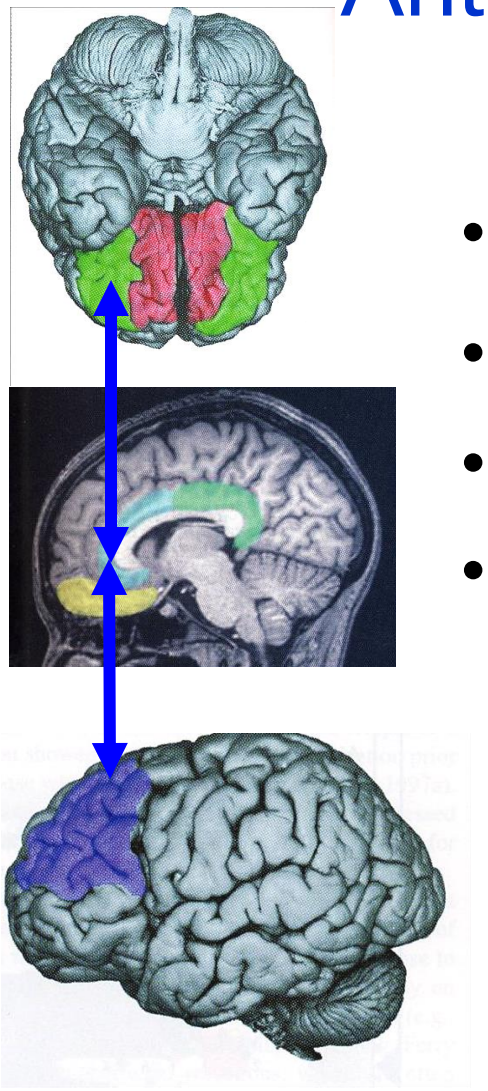




The amygdala connects with the hippocampus activating emotional memories that aid decision making.

Dolan, 2002, Emotion, cognition and behaviour, Science, 298, 1191-1194.
Adolphs,1999, Social Cognition & the human brain. Trends in cognitive sciences, (3), 12, 469-479.
Adolphs,2002, Neural systems for recognising emotion. Curr. Opinion in Neurobiol. 12, 169-177.

Anterior Cingulate Cortex



Conflict resolution

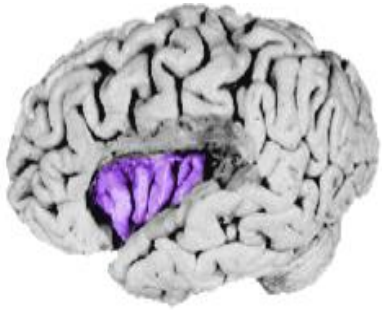
- Detects and evaluates errors.
- Suggests an alternative action.
- Emotional awareness
- Emotional regulation

Anterior Cingulate Cortex

- Divided into four regions, each of which seem to underpin a separate function
- Anterior region - executive function
- Dorsal region - memory processing
- Ventral region - emotional regulation
- Posterior region - evaluative processes

Bush, et al. (2002). Dorsal anterior cingulate cortex: A role in reward-based decision making. Proceedings of the National Academy of Sciences, 99, 523-528.

Insula



- Receives input from the thalamus & amygdala.
- Role in emotional awareness and interpersonal experience.
- Helps us understand the emotions of others.

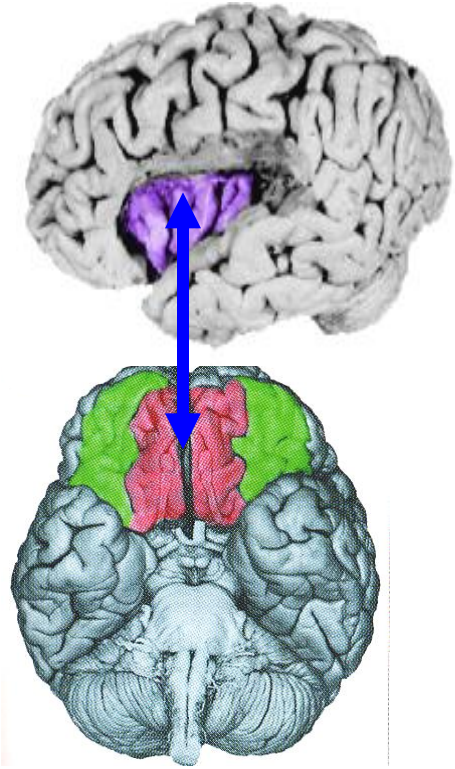
Empathy

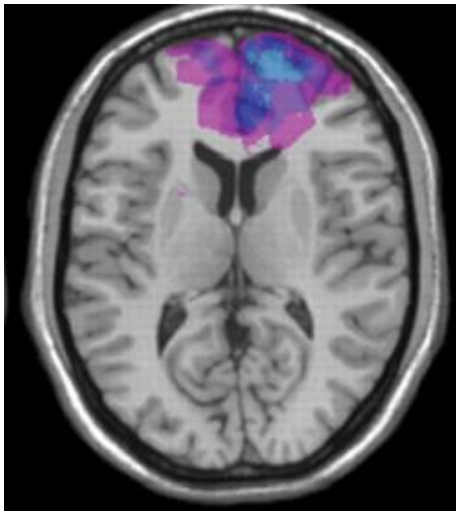
"The binding force of social cognition, allowing individuals to share experiences and understand each others perspective".

Eslinger et al 2002

Empathy

Associated with ventromedial prefrontal cortex



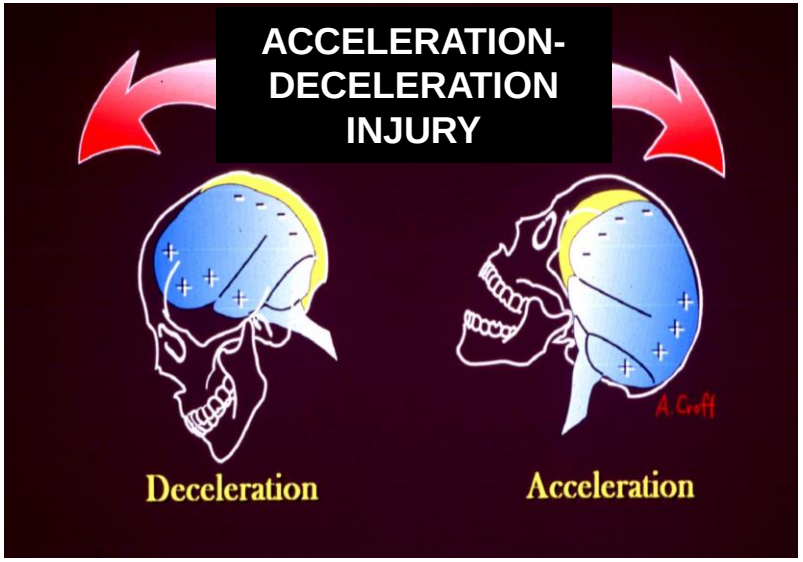


(Shamsay-Toory et al, 2004)

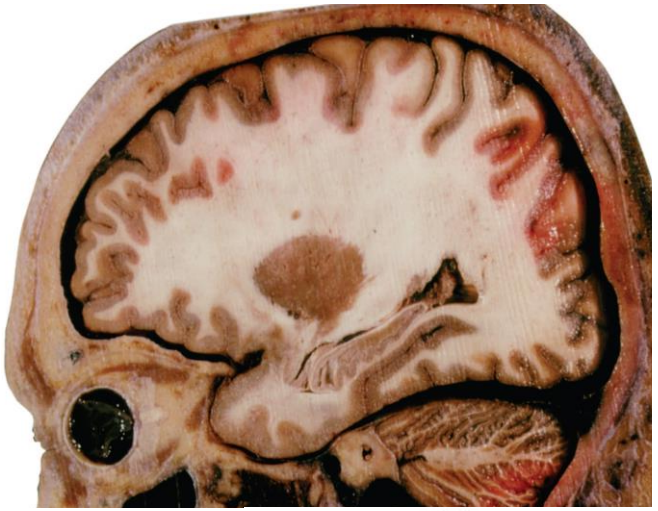
Impact of Traumatic Brain Injury

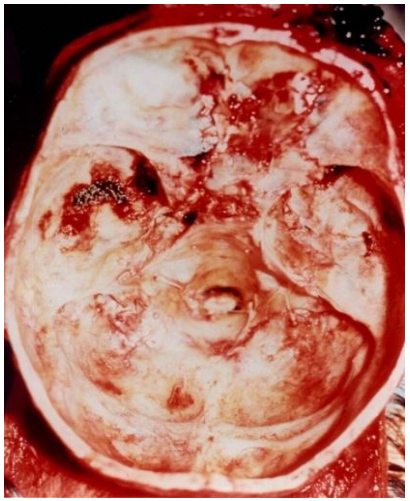
"Whatever the site of injury the principle location of damage is the frontal structures"

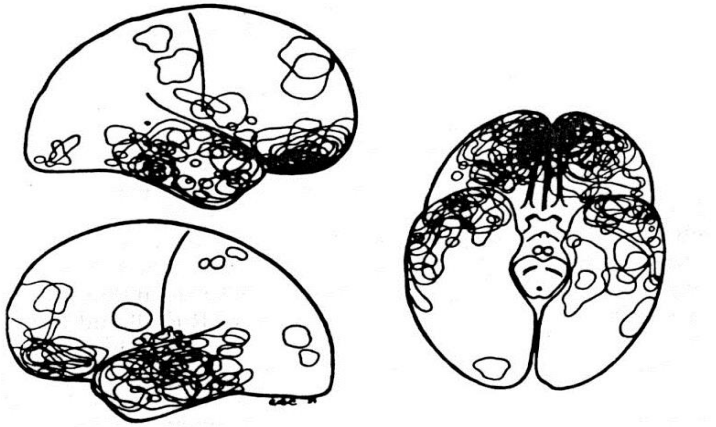
(Teasdale & Mendelow 1984)



Deceleration pressure gradients determine motion of brain, relative to skull







Contusions cluster around anterior temporal and basal frontal regions

Courville 1937

Impact of TBI on Behaviour Self-Regulation

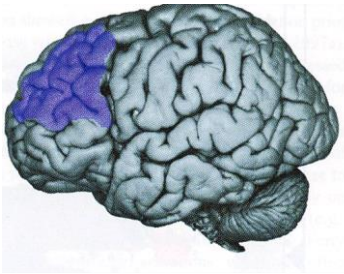
Cognition & Behaviour Self-Regulation

Inhibitory control is a key component of behavioral self-regulation.

It interacts with executive processes to guide adaptive interactions with the environment

(Fuster, 2002).

Dorsomedial & Dorsolateral PFC



- Planning & Organization
- Initiative & Spontaneity
- Sequencing & Prioritising
- Time Management
- Self monitoring
- Judgement.

Executive Functions

Mediate purposeful, goal-directed behaviour

Executive Disorder
(a lack of self-regulated behaviour)

- Unable to plan, organise, initiate, or sequence, activities.
  - Behaviour is aimless, impulsive, and fragmented.
- Unable to sustain goal directed behaviour.
  - Jobs started but not finished.
- Unable to meet time deadlines.
  - Poor chronological awareness.
- Unable to monitor and evaluate actions.
  - Behaviour has a ballistic character.

Loss of Mental Flexibility

- Unable to think flexibly.
  - Reliance on a daily schedule to order activities.
  - Less able to adapt behaviour to changing circumstances.
- A dichotomous style of thinking
  - Everything seen in black or white
- Loss of abstract thinking.
  - Can only deal in the here and now.
  - Unable to consider alternative strategies.
- Unable to see another person's point of view.
  - Opinionated. Rigid attitude.

A failure to apply intelligence adaptively

- Normal neuropsychological profile.
  - Knowledge remains intact.
  - OK with familiar tasks but unable to cope with novelty.
  - Some individuals can tell you how something should be done but cannot actually do it!
- Unable to translate intentions into actions.
  - A genuine desire to do something but an inability to initiate the behaviour.
  - Plausible, full of promises and good intentions, but lacks drive and purpose.
  - Impression of laziness; lack of motivation.

“Frontal lobe paradox”

“Persons with seemingly preserved intelligence fail to cope with demands of their occupation or profession.”

(Walsh, 1985)

Decision Making

Problem solving V's Social Cognition

Most self-regulatory behaviours are influenced by emotional reactions that arise from anticipating outcomes.

(Damasio, 1994)

- Help determine self-constraint.
- Important component in social cognition.

Somatic Marker Hypothesis

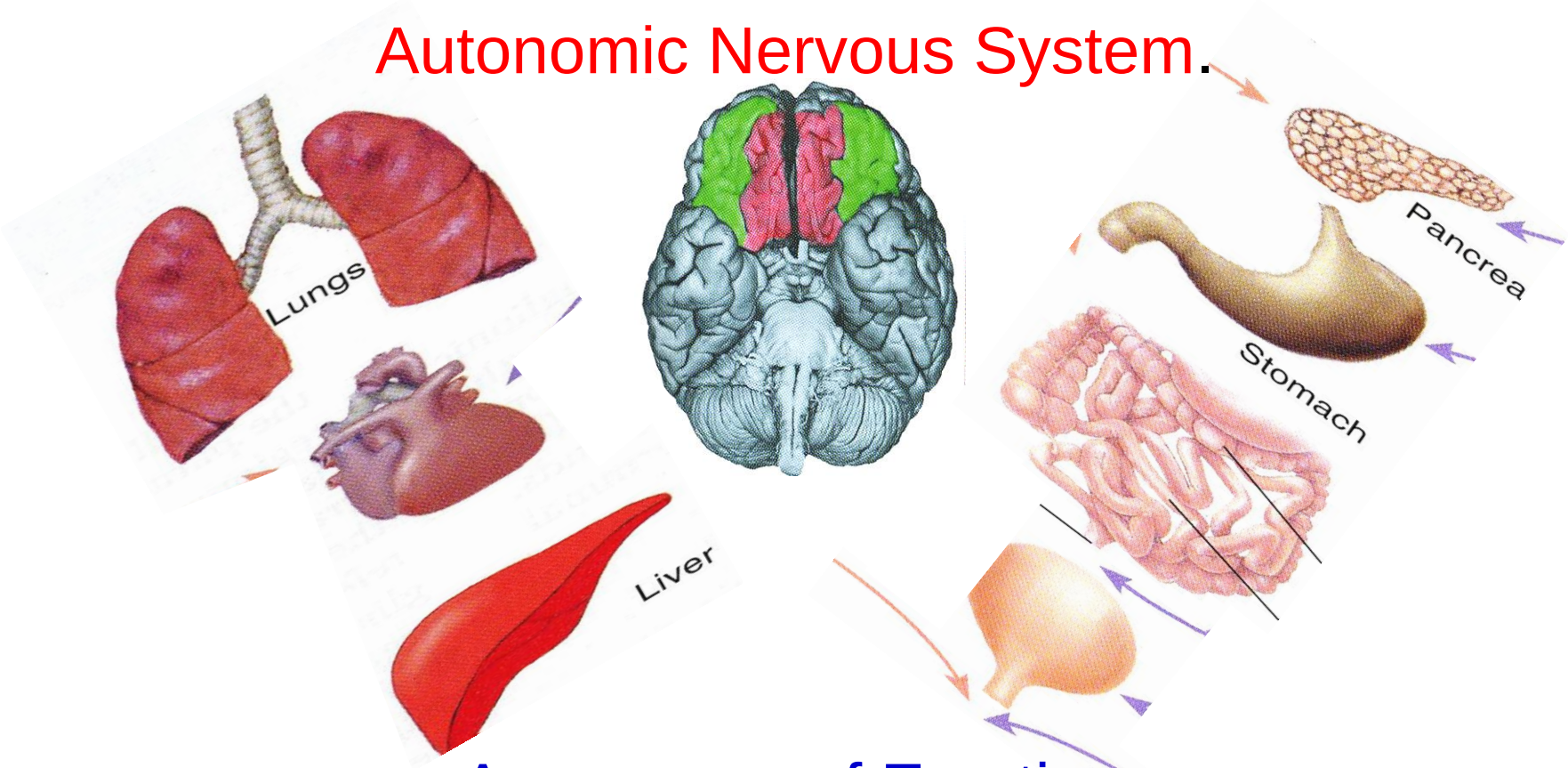
Damasio 1994

- Somatic markers - (gut feelings; an ANS response)
- Helps direct attention to the outcome of an action.
  - Aids decision making
- An automatic alarm system
  - Beware of the danger ahead if you choose this option.
- Allows us to think of alternative response options
  - Improves social judgement in risky situations
- Mediates emotional decision making.
  - How we **feel** about an outcome will mediate action.

Ventromedial Prefrontal Cortex

Links thoughts & intentions with reactions of the

Autonomic Nervous System.



Awareness of Emotions

Somatic Marker Dysfunction
(Ventro-Medial Dysfunction)

- No emotional intuition
  - Diminished sense of right or wrong.
- Poor decision-making in situations that involve ambiguity.
  - Difficulty choosing between options or actions with uncertain outcomes
- Unable to delay gratification
  - Choose immediate rewards
- Failure to think about consequences of their decisions or actions.

Ventro-Medial Dysfunction

Impaired capacity to learn from mistakes

"they make the same (bad) decisions even though they always lead to negative consequences".

Not due to any loss of intelligence or memory, as measured using conventional psychological methods.

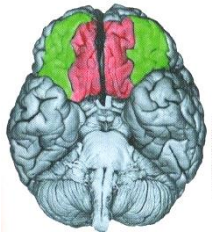
Bechara, Tranel, Damasio (2000).

Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. Brain 123 (Pt 11): 2189–202

Fellows, and Farah. "2007.

The Role of Ventromedial Prefrontal Cortex in Decision Making: Judgment under Uncertainty or Judgment Per Se?" Cerebral Cortex 17.11

Orbito-frontal Cortex



Anticipates reward value of an action.

Particularly when outcome is ambiguous.

Recognises social context as a determinant of social behaviour.

Social Judgement.

Inhibits socially inappropriate behaviour

Acts as the 'cerebral brake'.

Learning of social values.

Mediates moral development and 'normal' behaviour

Tekin, & Cummings. (2002). Frontal-subcortical neuronal circuits and clinical neuropsychiatry: An update. Journal of Psychosomatic Research, 53, 647-654.

Orbito-Frontal Dysfunction

Social Disinhibition

Poor awareness of social context

Failure to recognise/respond to social cues

Behaviour inconsistent with social circumstances.

Lack of social tact & discretion

Rude or embarrassing comments.

Impulsivity

Erratic & irresponsible behaviour.

Acting without thought of consequences

Unable to use recent experience to guide behaviour.

Orbito-Frontal Dysfunction

Loss of Mental Flexibility

Rigid style of thinking

Stereotyped Behaviour

Obsessional Personality

Menzies, et al (2008). Neuroimaging and neuropsychological studies of obsessive-compulsive disorder. Neuroscience and Biobehavioral Reviews, 32, 525-549.

Poor emotional control

Emotionally labile.

Shallow irritability.

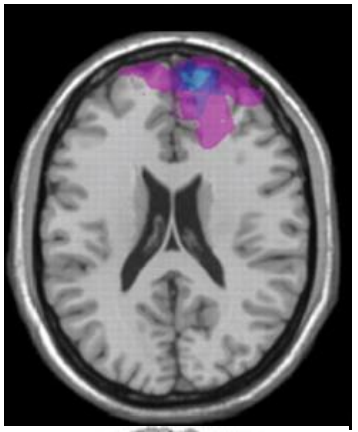
Poor temper control

Impact of Prefrontal Injury on Emotional Awareness:-

Empathy

Deficits in emotional empathy associated with:-

- right sided orbital lesions
- ventromedial lesions.
  (Shamsay-Toory et al, 2004)
- Insular
  (Schulte-Ruther et al 2007)



Two types of empathy:- Cognitive and Emotional

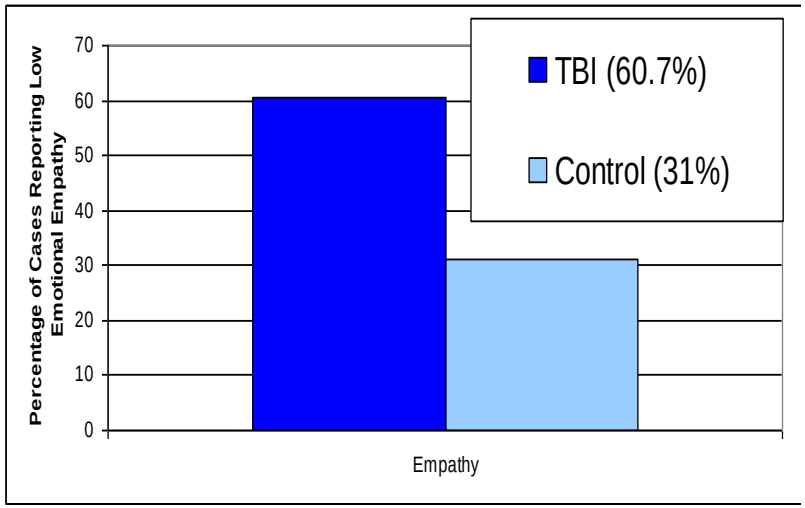
Cognitive Empathy

- Capacity to comprehend another person's situation - *Perspective-taking*
- Allows us to attribute an emotion to another person's perspective of their situation.
  - Permits mutual understanding of an emotional state.
  - Helps predict the behaviour of others
- But does not evoke an affective state in the observer.

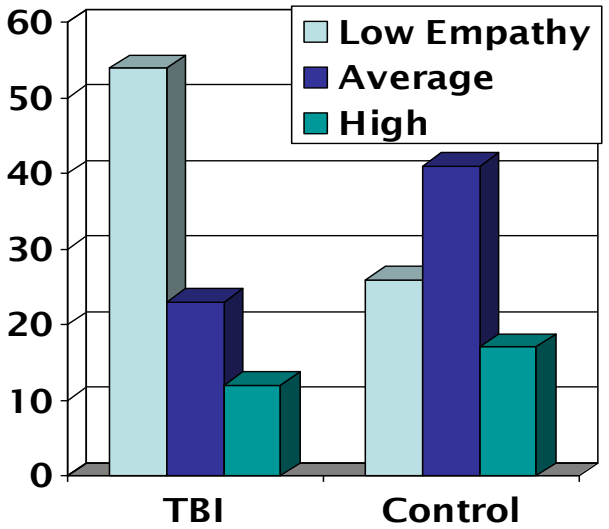
Emotional Empathy

- The ability to vicariously experience the emotions of others.
- Makes someone well-attuned to another person's inner emotional world
  - "I feel what you feel"
  - "You're upset so I'm upset"
- Motivates humans to behave altruistically towards relatives and friends.

Prevalence of Emotional Empathy After TBI



Test of Proportion: z = 3.919, P< 0001)



Low EE ≤ Z - 1.0 on BEES
Ave EE Z 0.5 -1.0
High EE ≥ Z 1.0

Wood R. Ll. & Williams, C (2008). Inability to empathise following traumatic brain injury. Journal International Neuropsychological Society. 14, 289-296.

Loss of Ability to Empathise

- Social veneer preserved
  - Relates well at a superficial (social) level.
- Egocentric & Self-centred
  - Neglects the emotional state of others
  - Decreased social awareness.
  - Reduced tact and discretion.
- Emotional blunting.
  - Insensitive/indifferent to the emotional state of others.
  - Fails to relate emotionally to other people.
  - No warmth or affection to partners and children.

Psychological Impact

- Rosenbaum and Najenson (1976)
  - Wives of TBI soldiers experienced greater distress compared to spinal cord injured and control group.
- Mauss-Clum and Ryan, (1981)
  - Wives reported higher levels of anxiety, lower mood, a greater sense of anger, and social isolation.
  - 32% reported being married to a stranger
- Oddy et al, (1978); Kreutzer et al, (1994); Linn et al, (1994)
  - Partners or spouses experience greater distress than parents.

Marital Discord

- Keutzer and Zasler (1989):
  - 38% of spouses report poor communication with their partner – 12% report this to improve
- Gosling and Oddy (1999):
  - Partners expressed gratitude but did not exhibit physical or emotional affection.
- Milders, Fuchs and Crawford (2003):
  - insensitive to partner's emotional expressions
  - impaired understanding of social situations and partner's intentions
  - failed to adjust behaviour in accordance with social rules and demands

Relationship Failure

- Anderson-Parente et al (1990).
  - less than a third of their sample remained married after 2 years.
- Stillwell and Stillwell (1997)
  - 30% of 234 severe patient's relationships ended in divorce 7 years post-injury severe.
- Wood and Yurdakul (1997).
  - 131 participants 5-8 years post-injury,
  - 49% ended in divorced or separated
    - (15.3% vs 33.6% respectively).
- Kreutzer (2007).
  - 48 participants 1 year post-injury
  - Divorce rate = 17%; Separation rate = 8%.

What explains a person's difficulty recognising, describing, and expressing feelings?

Alexithymia ?

A three factor Personality Construct

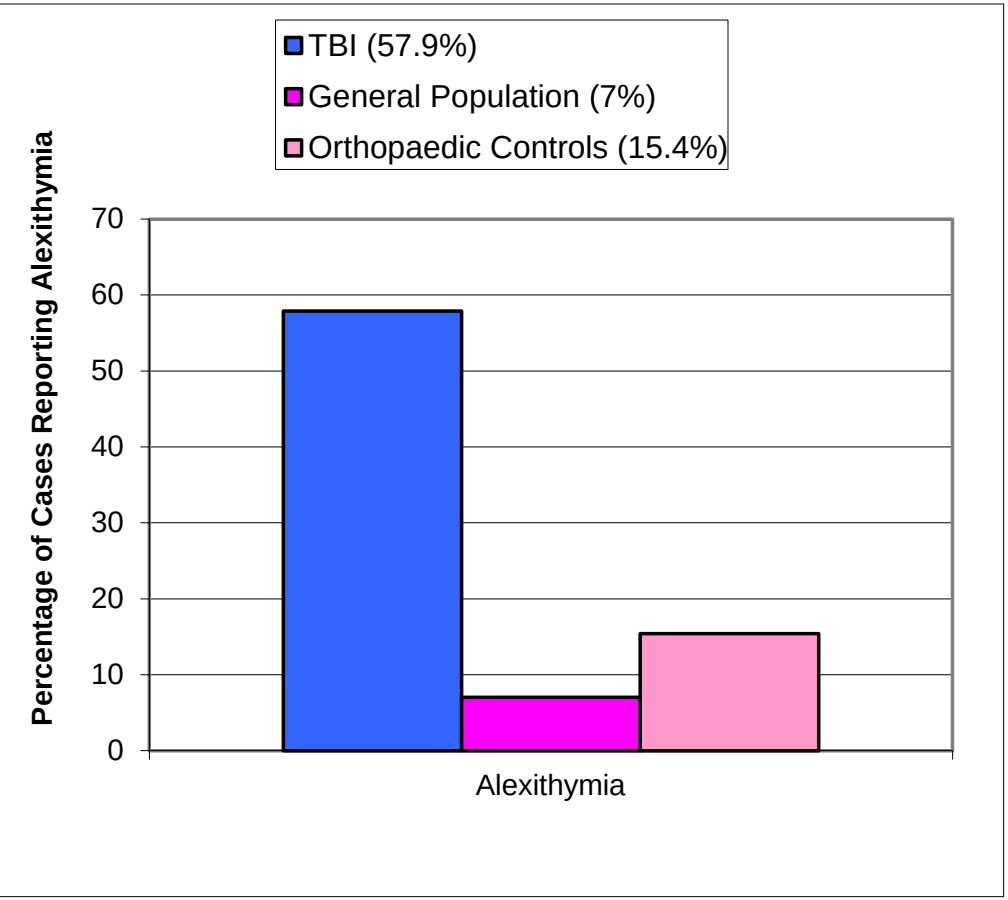
1. Difficulty identifying feelings

2. Difficulty describing feelings to other people

3. An externally-orientated thinking style

General Population Prevalence
7-10% (Pasini et al 1992)

Prevalence of Alexithymia after TBI



Psychological Impact

- Do not recognise their own emotions
  - Therefore insensitive to emotional state of others.
- Emotionally cold
  - Little warmth or affection to partners and children.
- Superficial social veneer
  - Lack social tact and discretion.

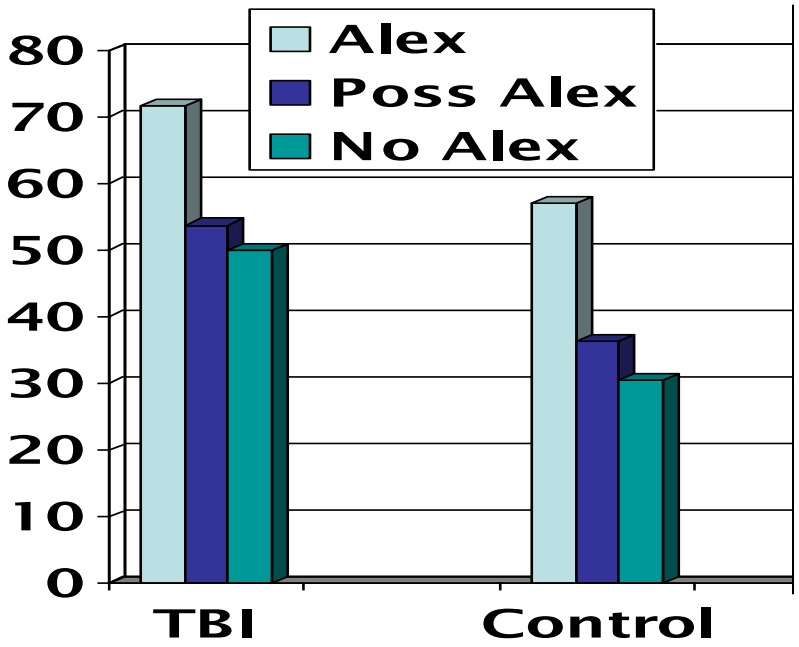
Wood & Williams (2007).*Neuropsychological correlates of organic alexithymia*. Journal International Neuropsychological Society. 13, 471-479

Alexithymia:
Associated with damage to a number of cerebral structures

- Corpus Callosum (TenHouten et al. 1985, 1987)
- Right anterior cingulate (Lane et al 1997; Gundel et al 2004)
- Medial Orbital PFC (Ochsner et al, 2002)

Therefore, pathology of alexithymia reflects that of TBI.

Alexithymia & Inability to Empathise



Percentage of alexithymic cases reporting low empathy

TBI r = - .323, p < .005
Control r = - .473, p < .001

Stronger negative relationship in the control group -

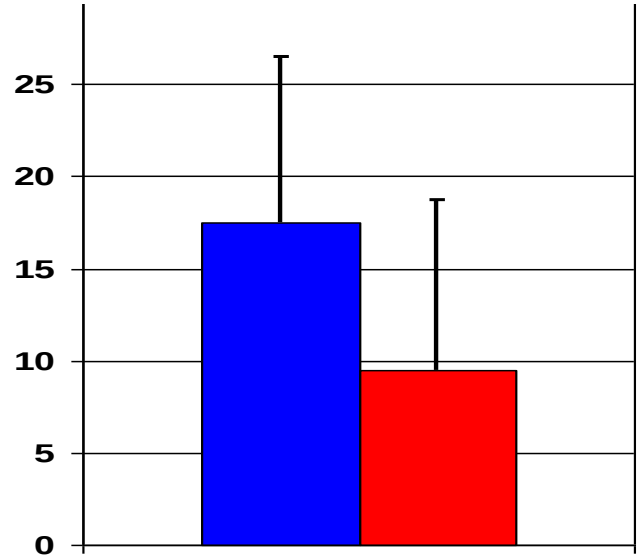
Williams, C. & Wood, R. (2009) Alexithymia and emotional empathy following traumatic brain injury. Journal of the International Neuropsychological Society: Vol 52; supplement S2.

Impact on Somatisation

The inability to recognise and/or describe one's own emotional state increases the risk that psychological distress will be expressed as physical symptoms.

Alexithymia & Somatisation

SCL-90 measure of somatic distress



N = 83/196 TBI cases, mixed severity

Alexithymia M = 17.47, SD = 9.03

No-alexithymia M = 9.50, SD = 9.19

t [81] = 3.838, p < .0005

Alexithymia accounted for 17.7% variance in somatisation scores

R2 = .177, F [1,81] = 18.595, p < .0005.

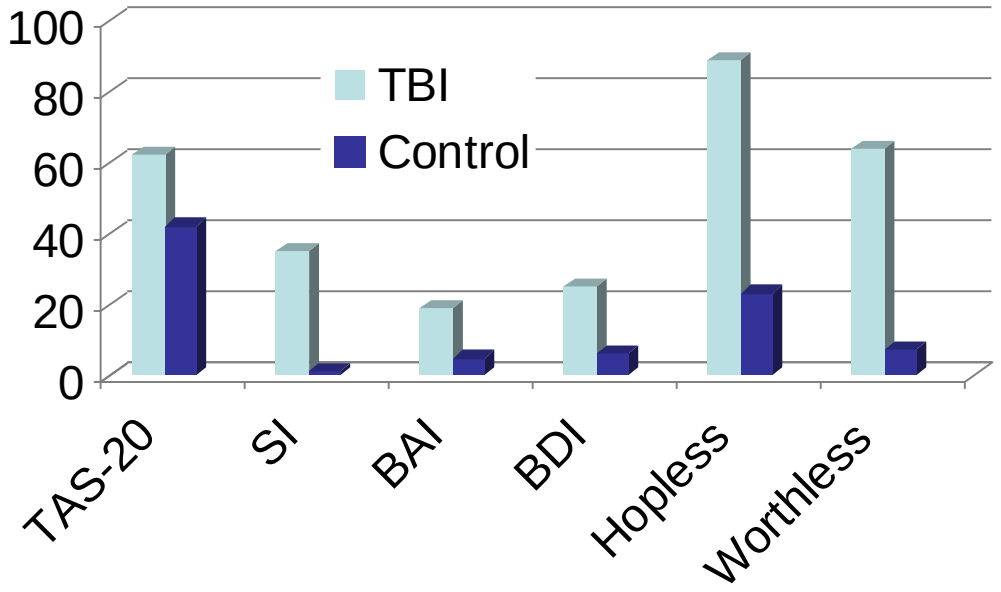
Wood, R. Ll., Williams, C. & Kaylani, T. (2009). Alexithymia and somatisation in a traumatic brain injury sample. Brain Injury. 23, 7, 649 – 654

- TBI cohort recorded a significantly higher proportion of alexithymia (63.9%) than rates reported for
- depression 45% ($Z = 2.65$, $p < .005$)
- social phobia 28% ($Z = 3.87$, $p < .0001$)
- panic disorder 34% ($Z = 4.02$, $p < .0001$)
- but not anorexia 68% ($Z = -0.56$, $p > .05$).

Alexithymia & Suicide Ideation

Wood, R.Ll., Williams, C. & Lewis, R. (2010). The Role of Alexithymia in Suicide Ideation after Traumatic Brain Injury. *Journal of the International Neuropsychological Society, 28, 1-7.*

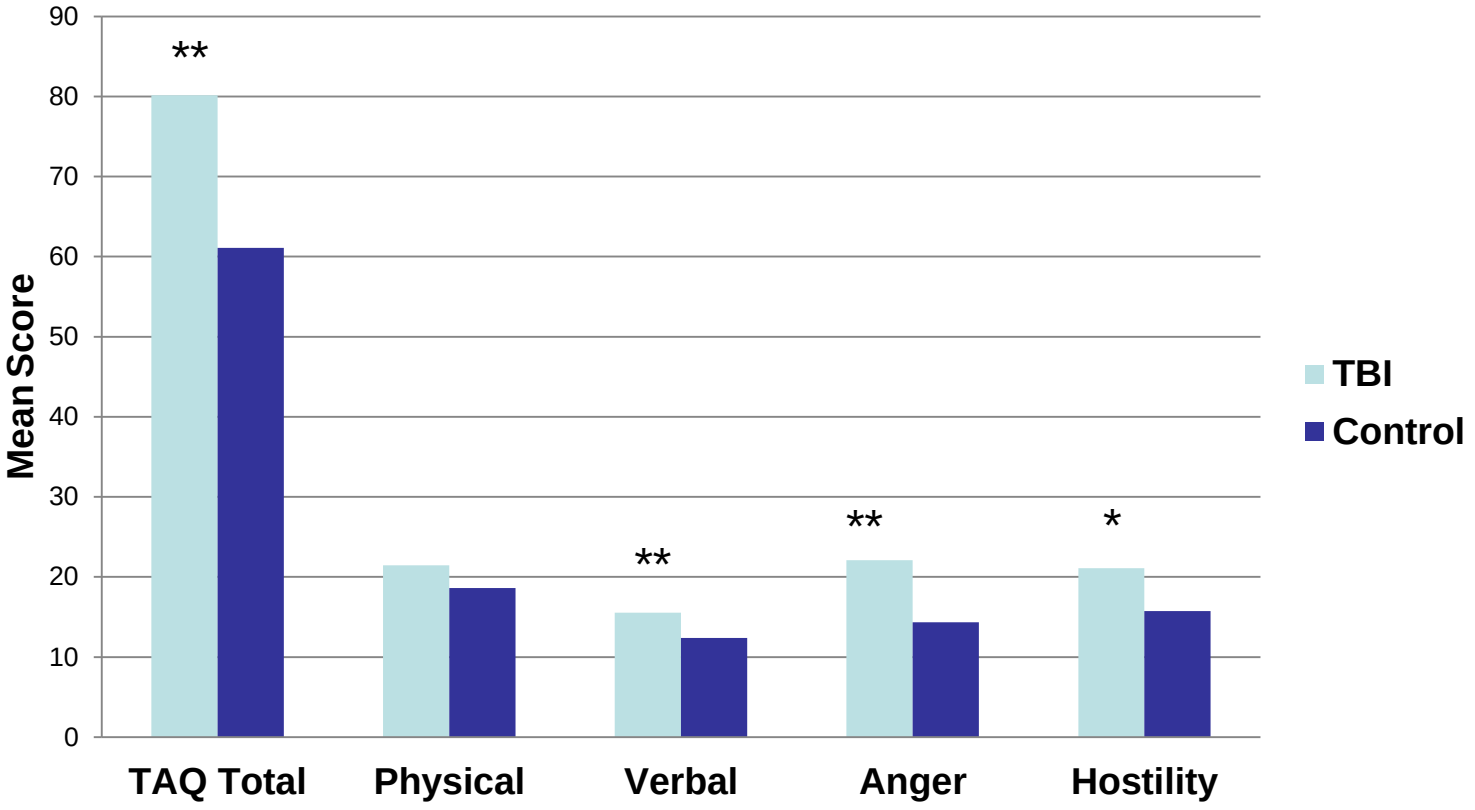
N = 105 TBI: Controls matched - Age; gender, estimated VIQ



Direct logistic regression correctly classified 67.6% of cases.
Odds ratio for TAS-20 scores indicated that for every point increase on TAS-20, the odds of reporting SI increased by a factor of 1.035.
Only worthlessness made a unique significant contribution to the model.

Alexithymia & Aggression

Higher ratings of aggression in the TBI compared to the control group (**= p< .0005; *= p<.001).



Developmental Implications

Ventral PFC Dysfunction

People with lesions in the vmPFC show characteristics similar to those with psychopathic personality traits.

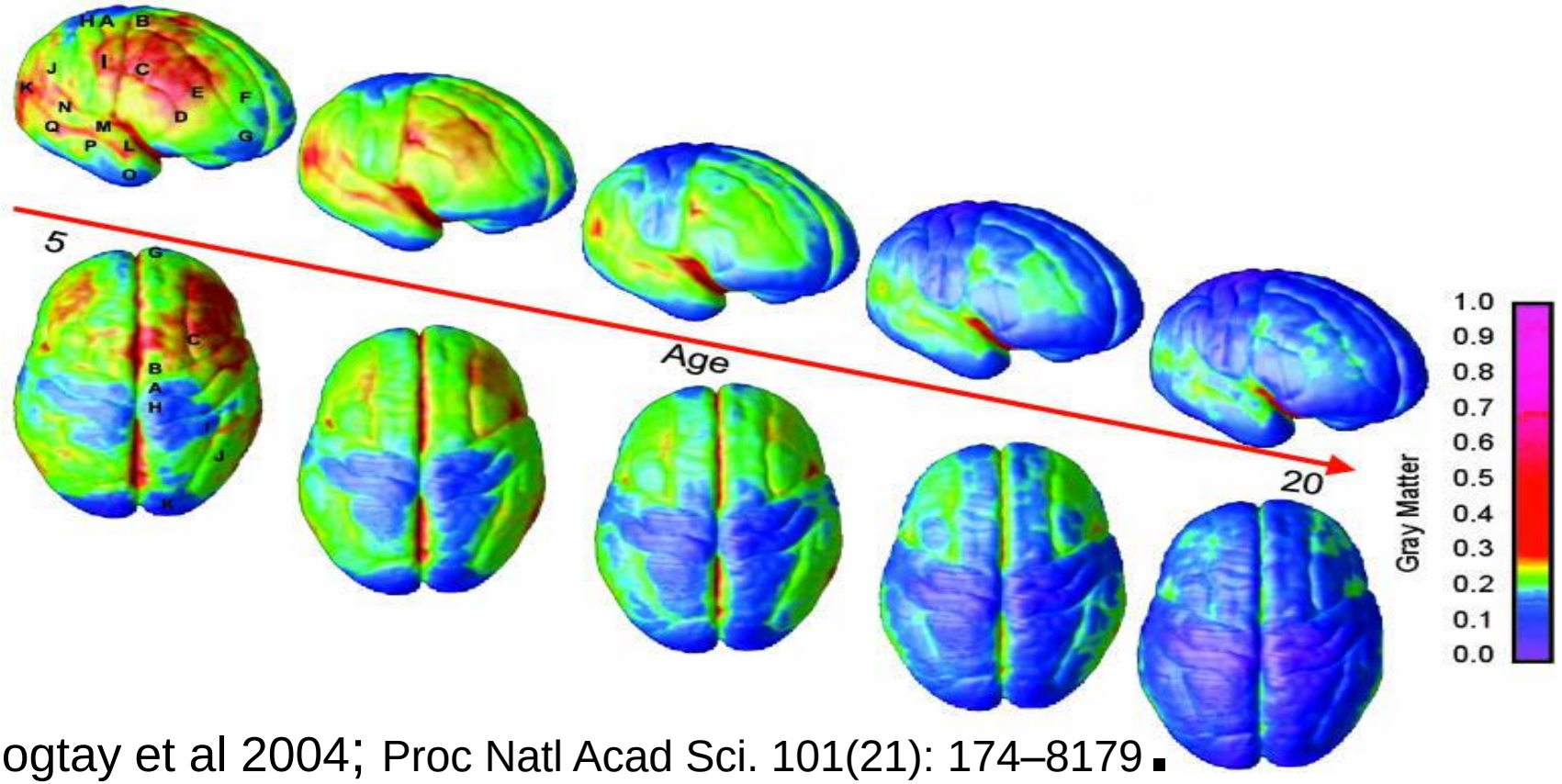
Motzkin; Newman; Kiehl; Koenigs, (2011).

"Reduced prefrontal connectivity in psychopathy".

*The Journal of Neuroscience **31** (48): 17348-48.*

Map of human cortical development.

Cortical grey matter development
between ages 5–20 years.



Gogtay et al 2004; Proc Natl Acad Sci. 101(21): 174–8179.

Implications of TBI in Childhood

- Delayed maturational development
  - ‘Childish’ behaviour
- Social cognition not equal to physical development.
  - Slow to recognise and respond to social cues
- Lack of emotional sensitivity.
  - Less able to experience or exhibit age-related empathy

- Unable to delay gratification
- Impulsive decision making.
- Lack of tolerance
- Shallow irritability
- Quick temper
- No remorse
- No moral compass

Lack of Moral Template

- PFC damage in childhood prevents or delays the development of a moral or social frame of reference.
- Children or adolescents who suffer damage to the vmPFC are more likely to engage in selfish actions that break moral rules or cause harm to others.
- ***Taber-Thomas, et al. (2014).***
- *Arrested development: early prefrontal lesions impair the maturation of moral judgement. Brain, 137(4), 1254-1261.*

Failure of Moral Develoment.

- Indifference to punishment and reward.
- No sense of guilt and remorse; no moral responsibility improbable (Anderson et al, 1999).
- Increases the risk of ‘Pseudo-psychopathy (Blumer and Benson,1975)
  - Acquired behaviours similar to those seen in psychopathic individuals.
- Link between prefrontal cortex injury and a lack of moral reasoning in criminal psychopaths.
  - Adrian Raine (2000)

Psychopathy

- Two patients injured < 10 yrs: 20 and 23 years old at time of follow up
- Intellect, memory and language developed normally.
- Impaired decision making, unable to make realistic plans for the future.
- Disruptive behaviour - physical & verbal abuse.
- Sexual irresponsibility coupled with a lack of guilt or remorse.
- Lack of empathy for others and an egocentric perspective on the world.
- Failed to acquire social and moral knowledge. Both exhibited moral reasoning appropriate for a ten year old
- "*Behaviour akin to that of a psychopath*"

Anderson, et al (1999). Impairment of social and moral behaviour related to early damage in human prefrontal cortex. *Nature Neuroscience* , 2, (11), 1032 – 1037.

TBI & Criminality

60% of criminals in British prisons have a history of head trauma.

(Williams et al 2010. Brain Injury Vol. 24, No. 10 , Pages 1184-1188)

- "Over 60% reported 'Head Injuries'.
- 16% had experienced moderate-to-severe TBI
- 48% mild TBI.
- Adults with TBI were younger at entry into custodial systems
- Reported higher rates of repeat offending.

Aggression

Classifying Aggressive Behaviour After TBI

Two processes mainly responsible for aggression after head injury.

Lishman (1978). Organic Psychiatry. Blackwell, London

1. Loss of inhibitory functions or modulatory controls.
   - Impulsive aggression
2. Episodic behaviour produced by sudden spontaneous electrical disturbances.
   - Episodic aggression

Impulsive Aggression

Phenomenology of Impulsive Aggression

- Present from an early stage of recovery.
  - Irritability evolves into impulsive aggression
- Low frustration tolerance
  - Quick temper.
- Disproportionate reaction.
  - Angry reaction escalates out of control
- Verbal outbursts more common than physical assault.

Impulsive Aggression

- Personality
  - Little/no remorse.
  - Angry disposition
  - Attribution of blame
- Relentless
  - Family in constant state of tension

"Walking on eggshells"

Impulsive aggression in general population associated with certain risk factors

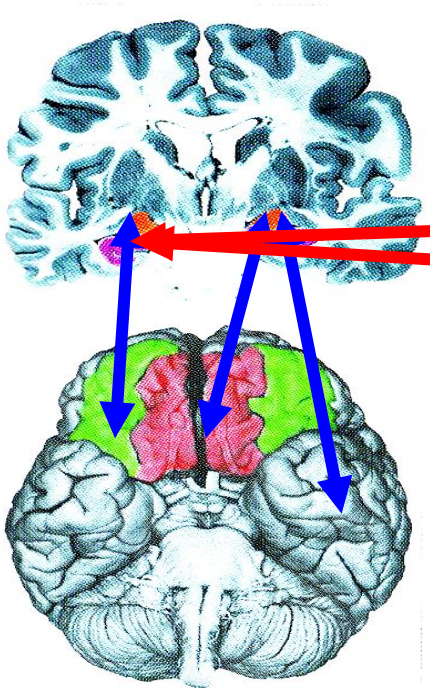
- Low premorbid IQ, (poor verbal skills)
- Low socioeconomic status
- Male gender.
- Younger age group,
- Poor pre-accident social functioning,
- Pre-accident alcohol and substance abuse.

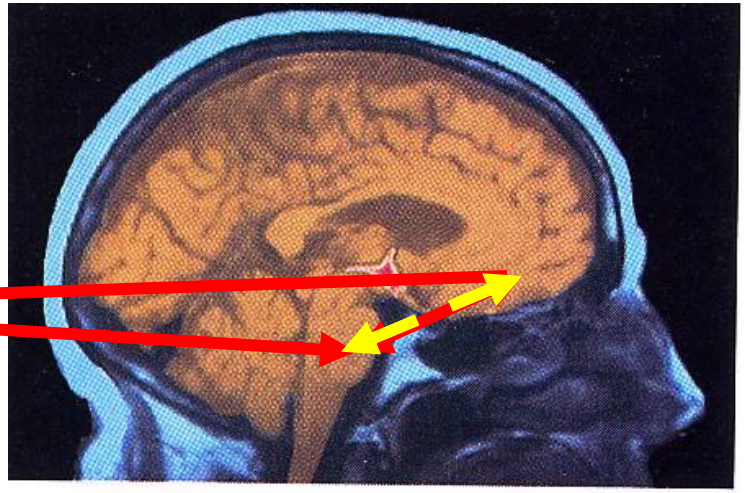
Many people in the TBI population conform to these risk factors

Emotion Regulation Circuit
Amygdala-Prefrontal Cortex-Brain Stem

Reciprocal pathways from amygdala to VFC & brain stem.

Determine response magnitude during fear & anger.





Amygdala activates brain stem startle reaction

Orbito-frontal modulatory control mechanisms activated.

Damage to this circuit can diminish or abolish inhibitory mechanisms.

Damage to startle response mechanism

- Pathway from central nucleus of amygdala to nucleus pontine reticularis in brain stem
  - Determines startle response magnitude during fear & anger.
- Amplifies brain stem startle circuit, activating orbito-frontal modulatory control mechanisms.
- Damage to this circuit can diminish or abolish the fear-potentiation of the startle response
- Therefore, OFC is not activated and does not exert any inhibitory control

Episodic Aggression

- Episodic behaviour produced by sudden spontaneous electrical disturbances.

Behavioural Phenomenology

- “Mood swings”
  - Transient alteration in mood and behaviour
- Depression the most reported symptom
- Anger the most frequent feature
- Outbursts preceded by:-
  - Period of tense, restless behaviour
  - Argumentative, unreasonable disposition.
  - Socially withdrawn; Suspicious or paranoid state
- Followed by
  - A sense of relief (often remorse)

Case Study: Episodic Dyscontrol

- SD: Age 16
- PM history
  - No developmental problems
  - Average student
  - Good behaviour.
- Injury Details:-
  - Kicked in face by horse
  - UC ~ 10 minutes
  - PTA ~ 1-2 hours
  - CT scan - normal

- Resumed school 3 weeks after injury
  - ~ 3 months later started to exhibit behaviour problems.
  - Mixed with ‘bad crowd’ she previously avoided.
- 12 months post:- School exclusion
- 18 months:- Family couldn’t cope.
  - Social services involved.
- 24 months: (18 years old) left home (NFA)
- 30 months: Pregnant.
  - Baby taken into care.

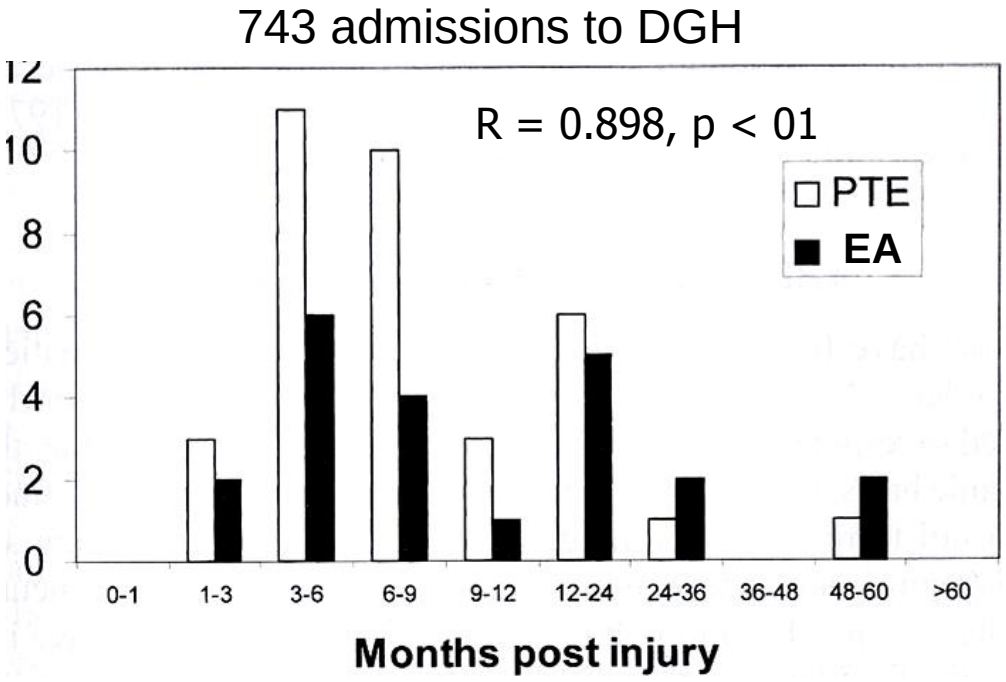
Behaviour Pattern

- Much of the time pleasant and easy going.
- Every 3 weeks or so she became a "*nasty witch*" ("Hen gwrach").
- Reported episodic behaviour pattern:-
  - Tense and restless ~ 1 day
  - Hypersexuality ~ 1-2 days
  - High alcohol consumption ~1 day
  - Volatile aggression ~1 day
  - Lethargic and morose ~1-2 days
- Returned to 'normal' behaviour

Pathophysiology

Is it a seizure-related disorder???

1. Delayed On-set ~ 4-6 months post injury



Eames & Wood 2003; *Episodic disorders of behaviour and affect after acquired brain injury;* Neuropsychological Rehabilitation, 13, 2, 241-258

2. Anger has explosive quality

"Explosive Diathesis" (Kaplan 1899)

On the role of head injury in the genesis of mental disease.

"Rage which follows the most trivial cause.... ....explosiveness of speech, cursing and outbreaks of violence, often directed at things; there may or may not be amnesia afterwards".

Explosive Rage (Hooper et al 1945)

"Aggressive rage ... which occurs after head injury.....is different from irritability. It has an explosive element which lifts it out of a background of normal mood or depression"

10 cases in 2000

3. Sudden Onset: Little or no warning.

Prodromal signs

- Low mood
- Unreasonable attitude (picky; critical; provocative).
- Social withdrawal.
- Tiredness.
- Change in facial appearance, or tone of voice.
- Suspiciousness/paranoia.

4. Duration

Minutes for aggressive outburst itself.

Can be irrational and emotionally ‘unreachable’ for several hours pre and post outburst.

5. Limited or no control over behaviour.

Control usually absent in respect of outburst itself.

Present in the direction of aggression

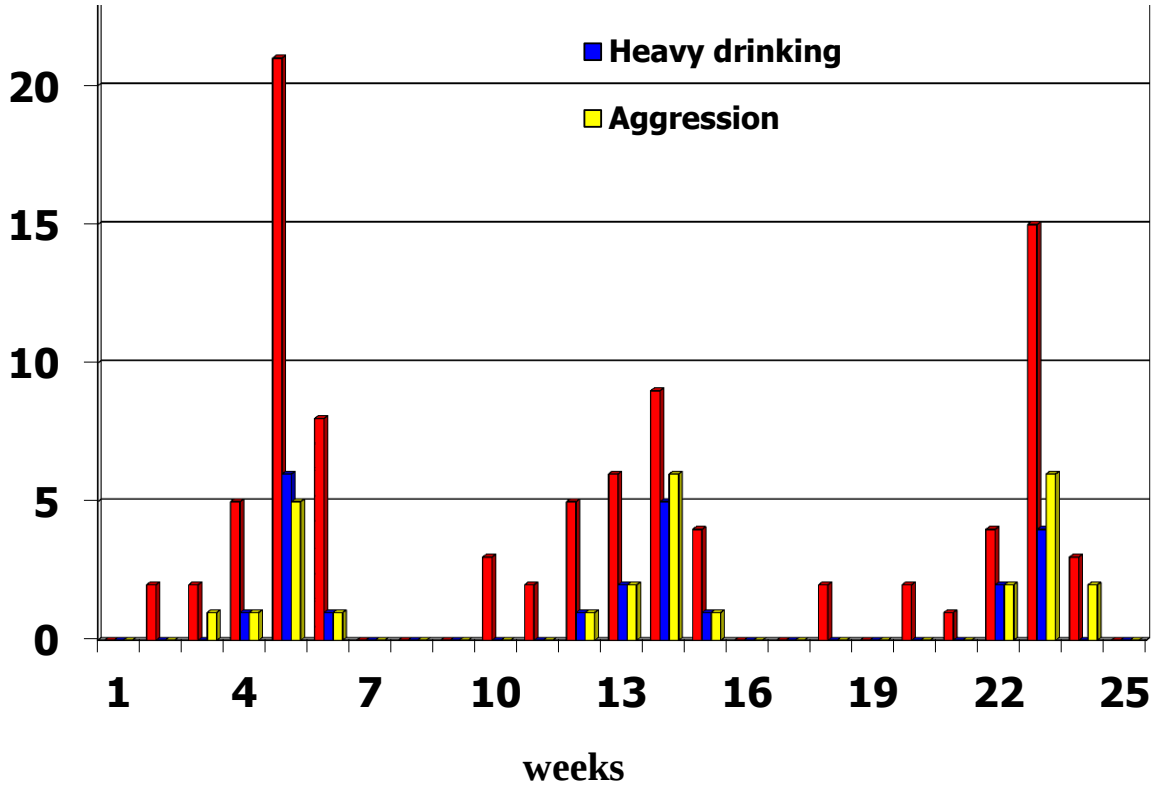
6. Sequelae

- Fatigue.
- Relief
- Remorse
- Imperfect memory

7. Unpredictable

Episodes are irregular

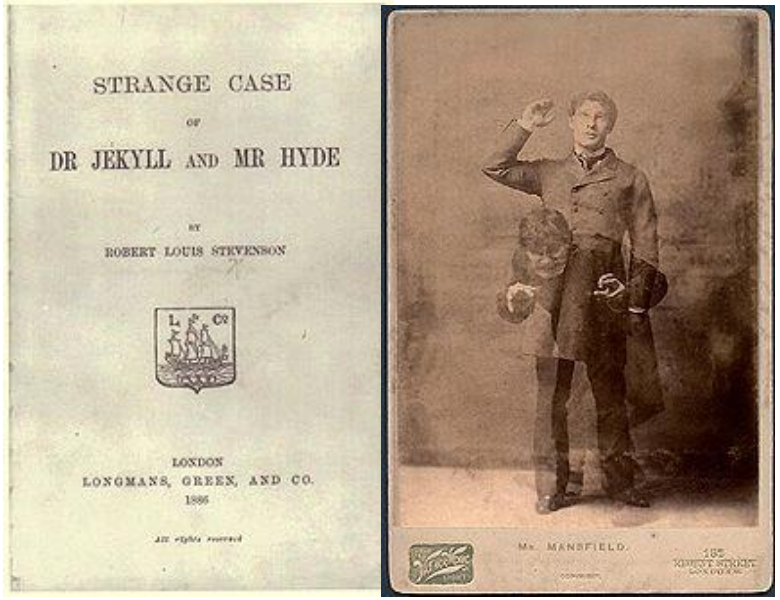
Intervals of days, weeks, or months.



8. Normal Self Between Episodes

- Relatives report that in between episodes the person exhibits their 'normal' personality
  - "He's like he was before the accident"
  - "It's like living with Jekyll & Hyde"

The Jekyll & Hyde Personality



“Episodic Dyscontrol Syndrome”

Mark & Ervin 1970; Violence And The Brain

Elliot 1982; J Nervous & Mental Disease, 170, 680-687

Episodic Dyscontrol Syndrome

Mark & Ervin 1970; Violence And The Brain;
Elliot 1982; J Nervous & Mental Disease, 170, 680-687

- *Explosive rage*:
  - Verbal or physical.
- *Onset:*
  - Often sudden, with little or no warning.
  - Increasing dysphoria or ‘pressure in head’.
- *Duration:*
  - Minutes (for aggressive outburst/tirade).
  - Hours (irrational and unreachable).
- *Control:*
  - Usually absent in respect of outburst
  - Present in the direction of aggression
- *Sequelae:*
  - Fatigue; relief; remorse;
  - Imperfect memory
- *Pattern:*
  - Irregular and unpredictable,

EDS
Not specific to brain injury

Ideopathic EDS V's TBI Episodic Aggression

(based on GP records and interviews with relatives)

Ideopathic

- History of violent aggression
- Developmental personality disorder
- Specific learning disability or ADHD
- Pathological intoxication
- Males > Females

Post traumatic

- No pre-injury problems with temper control
- Normal personality development
- ~ 43% dyslexia, dyspraxia, or ADHD.
- No alcohol problems
- No gender bias

No Diagnostic Classification for EDS

- Closest classification is - Intermittent Explosive Disorder DSM-IV (312.34)
- Classified as an impulse-control disorder
  - Failure to resist aggressive impulses
  - Aggression out of proportion to stressor.
  - Serious assaultive acts or destruction of property.
- But also includes episodic characteristics!!
  - Discrete episodes
  - Prodromal sense of tension
  - Subsequent feeling of relief.

Intermittent Explosive Disorder

- Diagnosis depends on other mental disorders causing aggression being discounted.
- Must not be due to a general medical condition; e.g., head injury.
- Alternative diagnostic category –
  - Personality change due to general medical condition - *Aggressive type* (DSM IV 310.1)

National Co-morbidity Survey for IED

Kessler et al (2006, Am J Psychiatry. 63, 669-678)

Survey of 9,282 adults between 2001-2003.

Narrow Definition

- Serious physical assault or destruction of property.

Broad Definition

1. Verbal outbursts of aggression.
   - Abusive tirade
   - A sense of threat
2. Physical damage to property

Both definitions assume

- Discrete episodes
- Explosive character
- A ‘lack’ of control

Comparative Prevalence of IED & EA

Kessler et al 2006

Cases that met criteria for IED

- Narrowly defined (physical violence) = 7.3%
- Broadly defined (verbal aggression) = 5.4%.

Swansea Study

TBI cases that met EA criteria =

- Narrow definition = 12%
- Broad definition = 16%

9. Episodic Symptom Clusters

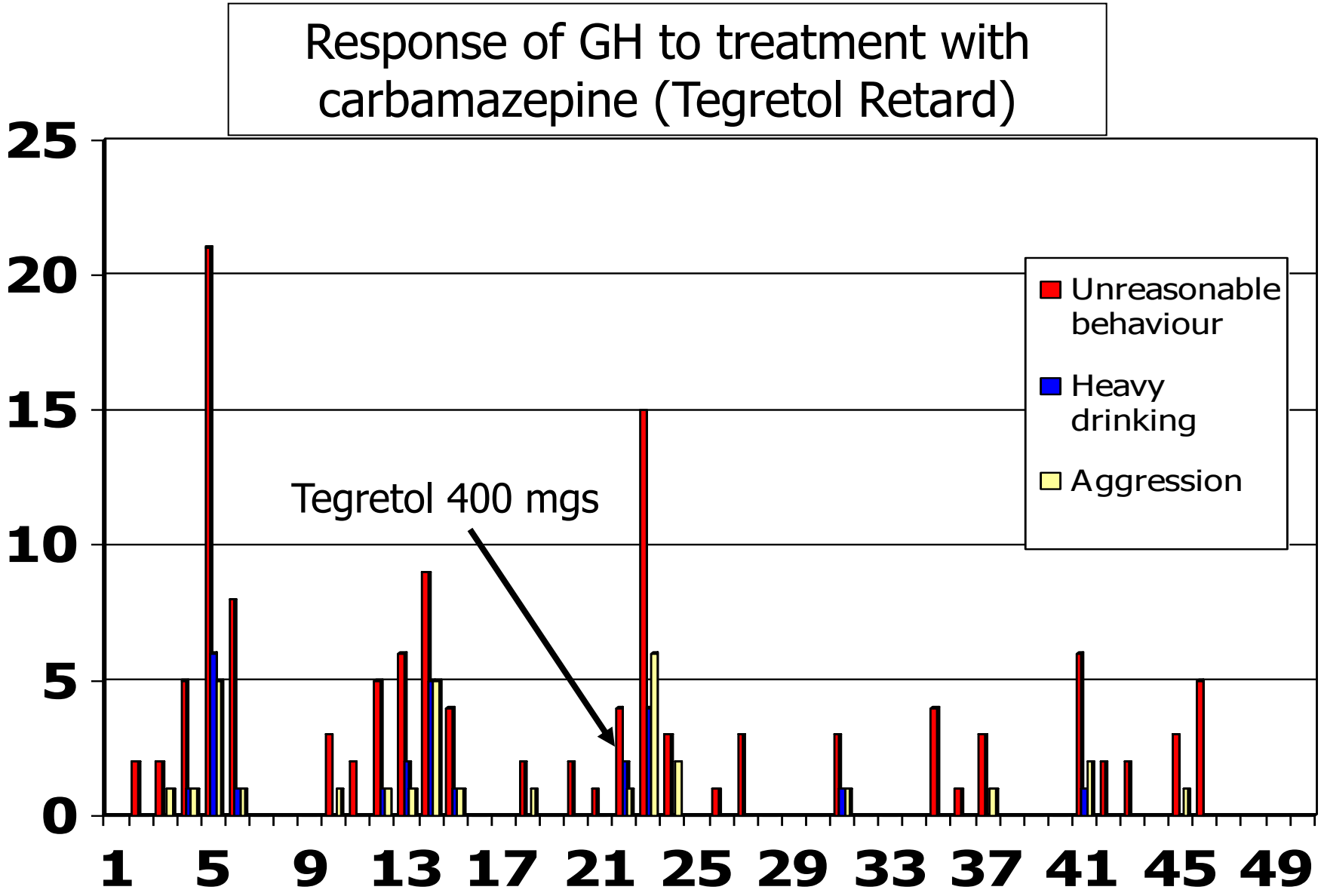
- Mood & temperament.
  - Tense, irritable, angry, ‘picky’.
- Personality changes
  - Suspicious/paranoid; socially withdrawn; unreasonable; negative; depressed.
- Fatigue
  - Exhaustion, malaise, not ‘normal’ tiredness).
- ‘Headaches’
  - Pressure pains; not ‘normal’ headache
- Cognitive deficits exacerbated
  - unable to concentrate, plan, organise, initiate (‘confusion’).

Treatment

Pharmacology

Case Study: GH.

- Premorbid history of dyslexia
- Normal behavioural development
- Age at injury = 16 yrs (RTA)
- Brief LOC; PTA ~ 12 hours
- CT Scan: small right frontal contusion
- 12 months post exhibited
  - Behaviour problems.
  - Executive dysfunction
- Admitted for rehabilitation 2 years post injury
  - (18 years old).


Response of GH to treatment with carbamazepine (Tegretol Retard)
25
20
15
10
5
0
1
5
9
13
17
21
25
29
33
37
41
45
49
Unreasonable behaviour
Heavy drinking
Aggression
Tegretol 400 mgs

Case Study: W R.

- Personal
  - Age 35; Married x 12 years; 2 children;
  - In regular employment as a store man.
  - Good social adjustment/No behaviour problems
- Injury Details
  - RTA 2002 (referred for treatment 2004)
  - GCS 8/15. PTA 2 days
  - Small right frontal contusion
- Neurology & Neuropsychology
  - Anosmia; Minor executive weaknesses

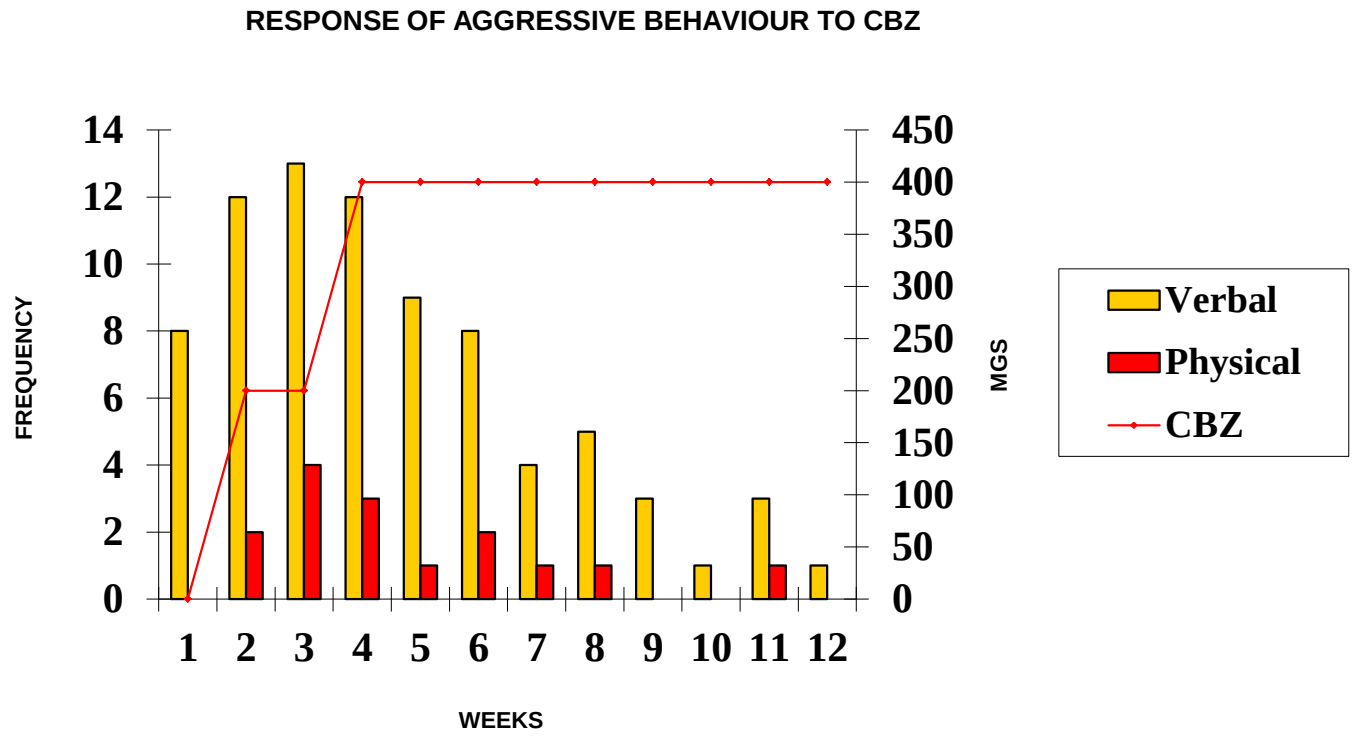
Behaviour and Personality

Episodic changes of mood & behaviour

- Negative and ‘depressed’
- Unreasonable, fault finding, accusing & suspicious manner.
- Altered facial features (“the long stare”)
- Altered tone of voice (terse, clipped comments)
- Socially withdrawn (avoided family contact)
- Abusive outbursts (threatening “*nasty*, *really in your face*”)
- Physical aggression
  - pushed wife; punched her on shoulder; smashed objects – even his garden shed!

TREATMENT

Response to carbemazepine (Tegretol Retard)



Treatment

Psychological Methods

Cognitive Behaviour Therapy

- A problem orientated form of therapy
  - Does not focus on pre-accident personality
- Targets perceptions and misattributions
  - Helps client identify errors or biases in how they perceive specific situations
- Uses language to
  - Reconstruct ideas and assumptions
  - Change beliefs and values
  - Promote self-regulated behaviour.

Methods to improve self monitoring

- Keep a record of incidents
- Agree on a method of receiving situational feedback or cues
- Discriminatory training
  - Awareness of both external and internal stimuli that signal the probability of a specific response.
- Recognition of social consequences
  - Meta-cognitive review of actions
  - Non-judgemental appraisal by S/O

Case Study RW
Impulsive Aggressive Outbursts

- Personal
  - Age 38; Married x 15 years; 2 children
  - Regular employment, motor mechanic.
- Injury Details
  - RTA 2003 (referred 2005)
  - GCS 5/15. PTA 4 days
  - Right frontal and temporal contusions
- Neurology & Neuropsychology
  - Anosmia; minor weaknesses of attention, memory, executive function.

Behaviour and Personality

- Unpredictable changes of mood
  - Poor tolerance of frustration
  - Tried to withdraw from family
  - Sudden angry outbursts
  - Threatening & abusive behaviour
- Reduced insight & judgement
  - Refused to accept medication
  - Previously refused psychological therapy

C-B-T

1. Awareness:
   - Recognition of impact of behaviour on wife and two children
   - Calm discussion of recent incidents (therapist as mediator)
2. Acceptance:
   - Wife in distress (on SSRI medication)
   - Children's behaviour affected (bed wetting and school problems)
3. Strategy:
   - Identify thoughts and emotional/physical stimuli that signal mood change

4. Verbal Regulation

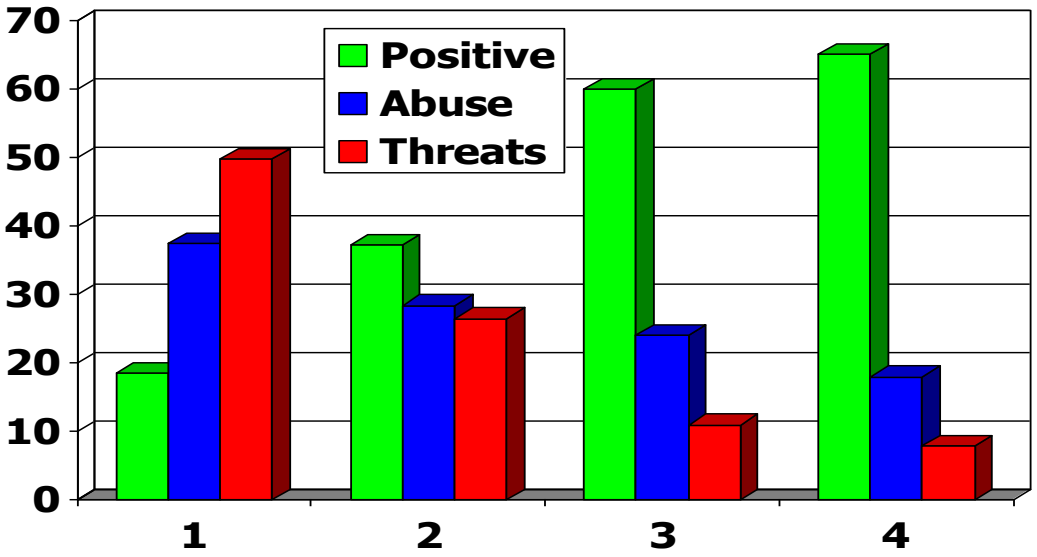
- Overt:-
  - “I am in one of my moods”
  - Tell family – “I’m having one of my bad days”
  - Remorse – “I’m sorry daddy’s not feeling very well today” (To explain need to withdraw)
- Covert:-
  - Think Positive – “I must look for the good things”
  - Control tone of speech – “I mustn’t sound nasty”

5. Family Acknowledgement and Feedback

- Family have to acknowledge this is an “illness” and that RW needs their support
  - “Is there anything we can do ?”
- Cues
  - “I can see that you look/feel angry”
  - “Would you like to be on your own?”
  - “Can you try and be nicer to the children”
- Emphasise neutral or supportive tone of voice from wife.
- Accept and acknowledge cues from wife

Impact of raised awareness on behaviour control

Ratings by wife in week prior to clinic



Monthly outpatient clinics

Swansea University

SWANSEA UNIVERSITY
PRIFYSGOL ABERTAWE

www.swansea.ac.uk

Altered Personality

- Intellect preserved.
- Poor Judgement
  - Rigid, concrete style of thinking.
- Reduced inhibitory control
  - Shallow irritability
  - Outspoken and tactless
  - Socially inappropriate
- Loss of empathy
  - Lacks warmth & affection
- Preserved social veneer
- Subtle but pervasive
  - Often family only ones to recognise

Case Study: Personality Change

- School teacher
- Normal developmental history
- Second (happy) marriage.
- One step-child (good relationship).
- At 40 years of age:-
  - Started to take an interest in child pornography.
  - Frequently visited child porn web-sites.
  - Attended ‘massage parlours’.
  - Clumsy attempt to concealed these behaviours.

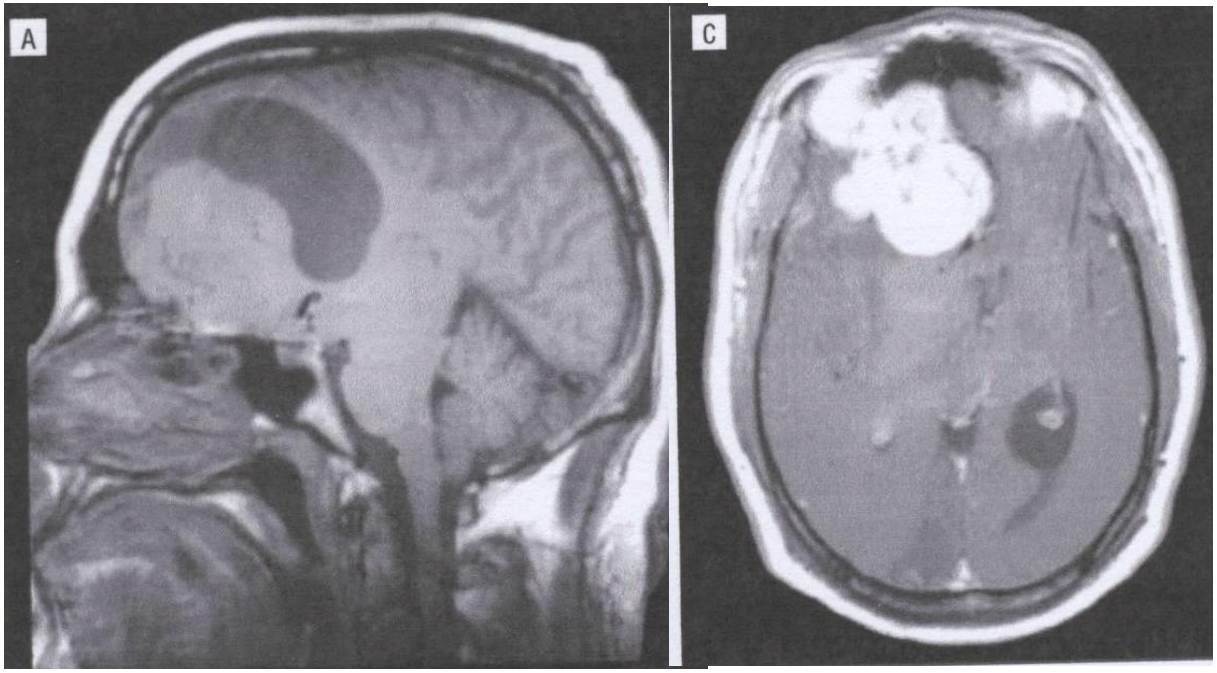
One year later

- Started making sexual advances to his step-daughter.
- Child told her mother.
- Arrested and removed from family home.
- Found guilty of child abuse.
- Classed as a paedophile & placed on sex offender register.
- Probation follow-up.
- Lost his job.
- Lived in lodgings – on benefits.

2 Years Later

- Started expressing fear he would rape his landlady.
- C/O severe headaches
- Expressed suicidal ideas
- Admitted to psychiatric hospital
- Sexually disinhibited to staff
- Abnormal neurological signs noted
  - Balance & coordination problems
  - Loss of smell & taste
- MRI scan – abnormal

Haemangiopericytoma



Mass in anterior fossa displacing right orbito-frontal lobe distorting DLPFC

OFC & Emotional Memory

- OFC selects information on basis of a feeling of ‘rightness’
  - A sense of familiarity
- OFC particularly active in olfactory memory
  - Perfume reminds one of a person or experience
- Involved in emotional processing of information
  - Recall event as:-
  - pleasant/rewarding or unpleasant/punishing
- Linked to amygdala
  - Part of expanded limbic system
  - Anterior temporal pole

Amygdala & Emotional Memory

- Amygdala encodes positive and negative emotional memories.
  - Probably not involved in retrieval of memories.
- Two neurological pathways:
  - A “hot” memory system centred on the actions of the amygdala
  - A “cool” memory system based on the actions of the hippocampus
    - Thomas, Laurance, Jacobs & Nadel (1995)

Interaction between amygdala and hippocampus

- Amygdala processes internal affective information
  - Le Doux 1993. Emotional memory systems in the brain. Behaviour Brain Research, 58, 69-70
- Hippocampus processes external environmental information.
- Hippocampus involved in acquisition of new information
  - converts short term memory to more permanent memory.
  - Key structure in memories for spatial location
  - Processes the spatial and temporal aspects of a changing environment.

Autobiographical Memory

- The hippocampus participates in the formation of declarative memories.
  - Declarative memory helps us verbalise our experience of life.
- Biographical memory
  - Hippocampus allows us to live in the present whilst having a sense of the past
- Puts emotional memories into context
  - Pleasant or unpleasant memories of past experience.
  - Creates a framework for decision making

Hippocampus & Emotional Memory

Hippocampus helps us put memories into context of time and space.

Do you remember where you were when this happened ?

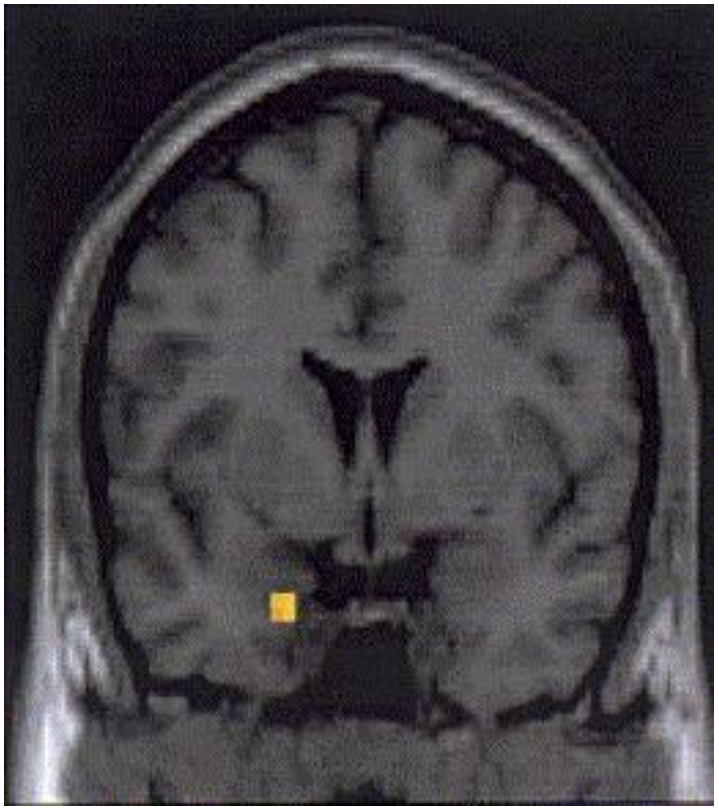
Flashbulb Memory

Hippocampus & Contextual Learning

- Important role in maintaining anxiety disorders.
- Context in which fear-inducing stimuli are encountered can themselves come to elicit fear.
- A rat repeatedly receives a foot-shock following a conditioning stimulus, (tone).
  - the rat will become fearful of the tone
  - and of the context in which conditioning took place (the test chamber)

Amygdala & Hippocampus

- Essential to understanding human phobic anxiety
- Negative expectation
  - generates anticipatory anxiety
- PTSD
  - A problem of not forgetting.
  - Protopopescu, 2005, Biological Psychiatry, 57, 5, 464-473



Amygdala response to PTSD-related words

Declarative V's Emotional Memory

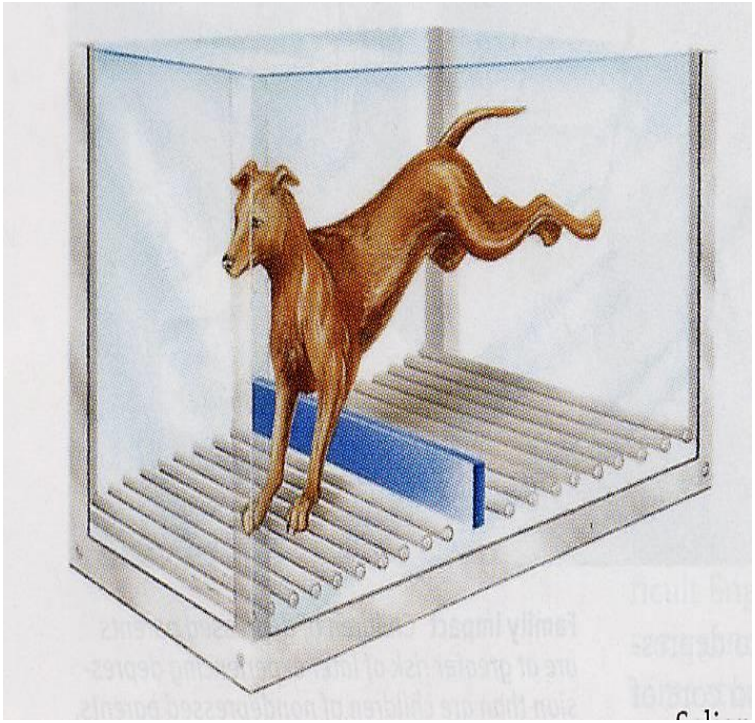
- Declarative memory
  - Based on conscious or deliberate learning of information; Episodic memory.
  - Soon deteriorates in most forms of dementia
- Emotional memory
  - Preserved, even in advanced states of dementia involving hippocampus (Alzheimer's Disease)
- Example of Claparede's patient
  - Declarative memory lost but retained memory of pain stimulus.
- Context for emotional memory may be lost.
  - Remember emotion but not why!

Role of amygdala in avoidance learning.

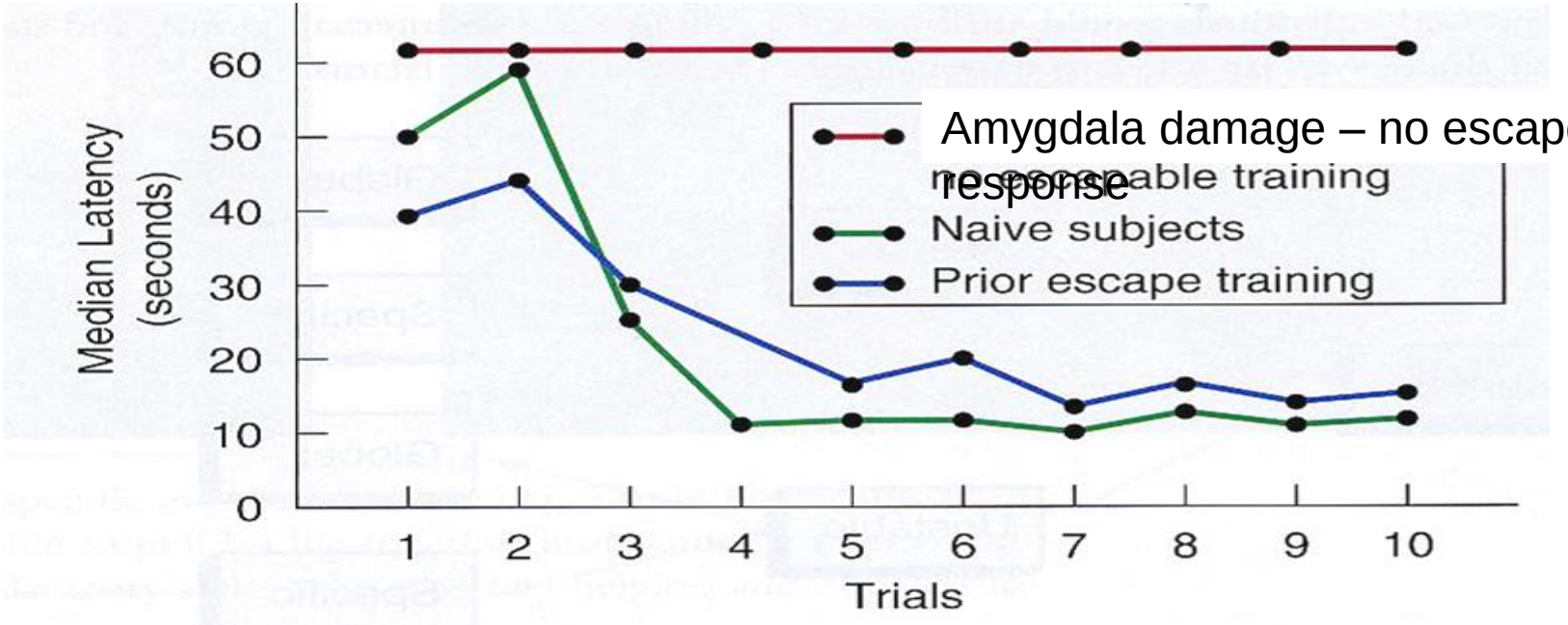
- Operant (or Instrumental) Conditioning Paradigm
- Animal first has to make a response
- The response is then either
    - Rewarded (positive reinforcement)
    - Punished
    - Reward withheld (negative reinforcement)

Shuttle Box Paradigm

- Neutral stimulus (buzzer) paired with electrified grid
- Animal eventually jumps across divider to safety
- Repeated pairings leads to association between buzzer and shock
- Animal recognises threat value of buzzer
- Learns avoidance (escape) response
  - Jumps over divider as soon as buzzer sounds



Avoidance response has survival value.

Role of Central Nucleus

- Central nucleus of amygdala important for aversive emotional learning.
- If central nucleus destroyed avoidance learning does not occur - LeDoux et al (1995).