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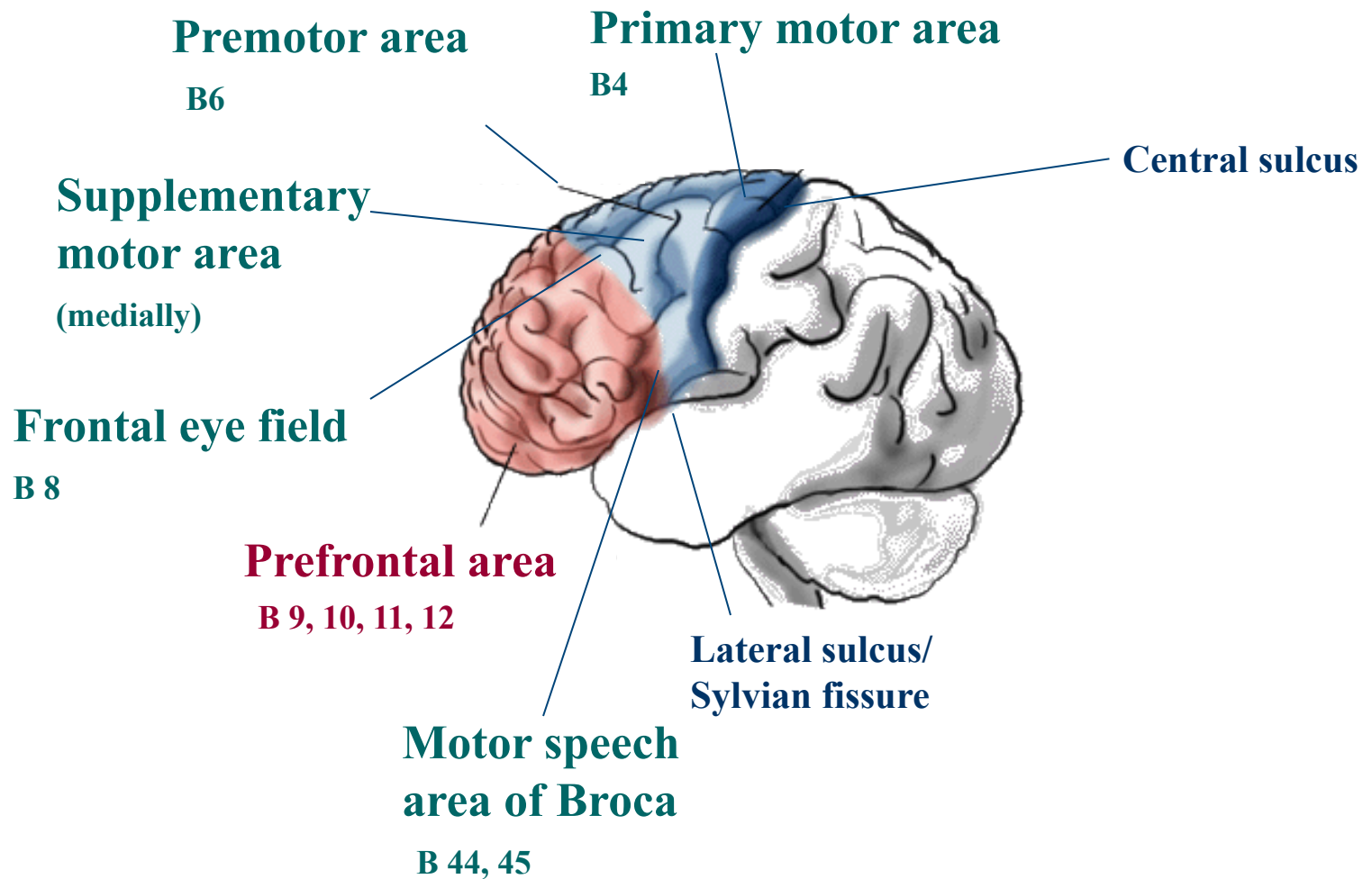
Frontal lobes & Dysexecutive Syndrome

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Frontal lobes

- **> 30% of human neocortex**
 - (compared to 10% of non-human primates)
- **Crucial to “higher order” cognitive functioning, personality & behaviour**



Applied anatomy

- Frontal lobes can be divided into 5 major areas:
 1. Motor area (primary motor cortex) – occupies precentral gyrus
 2. Supplementary motor area – ant. to motor strip; coordinates and plans motor activity
 3. Frontal eyes fields – mediate volitional and involuntary eye movements & important for spatial awareness
 4. Broca's area – inferior prefrontal region in the dominant hemisphere
 5. Prefrontal cortex proper – 3 subdivisions:
 - dorsolateral
 - Orbital
 - mesial

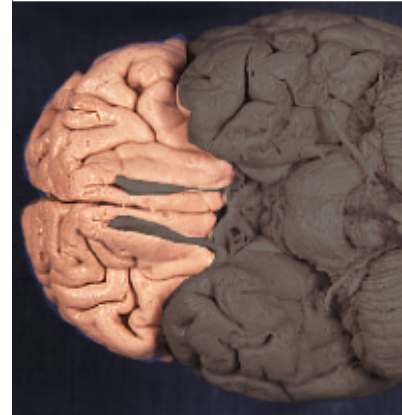
Dorsolateral aspect



Medial aspect



Inferior orbital aspect



Applied anatomy

- Prefrontal cortex = the conductor of intellectual functioning.
- Richly connected to all other subordinate cortical and subcortical structures.

Frontal Lobes

- Damage to prefrontal areas often produces devastating deficits.
- Traditional frontal lobe tests don't really capture the behavioural aspects of frontal dysfunction.
- Observation and informants are the key

Cog. Functions attributed to frontal lobes

- Adaptive behaviour:
 - Abstract conceptual ability
 - Set-shifting / mental flexibility
 - Inhibitory control
 - Problem solving and strategy formation
 - Planning
 - Self-monitoring
 - Initiation

Cog. Functions attributed to frontal lobes

- Sequencing of behaviour
- Decision making
- Temporal-order judgements
- Personality – esp drive, motivation & inhibition
- Social behaviour incl. Theory of mind
- Affect
- Motivation

Cog. Functions attributed to frontal lobes

- These abilities can be divided into 2 groups that correspond to anatomical divisions of the prefrontal cortex:
 - Executive abilities – dorsolateral prefrontal Cortex
 - Social cognition, inhibitory control and emotion – orbitomesial regions

Executive abilities

- The unique human ability to:
 - Initiate, plan and organise
 - Set goals
 - Attainment of goals whilst avoiding distractions
 - Remain flexible and responsive to changing contingencies

Executive abilities

- Frontal patients tend to:
 - Be distractible
 - Perseverate
 - Show mental stickiness
- Frontal patients display difficulties with:
 - Planning
 - Anticipating changes in the environment
 - Learning from errors
 - Filtering out interference from irrelevant stimuli
 - Shifting from one task to another
- The above leads to problems in:
 - Problem solving
 - Deducing concepts
 - Making analogies

Executive abilities

- Multiple tests:
 - Strategy formation:
 - Wisconsin Card Sorting Test
 - Tower of London
 - Initiation & monitoring:
 - Verbal fluency tests – show impoverishment in generating exemplars, impaired search strategy & tendency to repeat the same items

Executive abilities

- Dual task performance tests – highlight severe difficulties for frontal patients.
 - Remember, working memory is dependent upon the frontal lobes.

Social cognition, inhibitory control & emotion

- Damaged orbitomesial frontal lobes can cause:
 - profound changes in personality and behaviour
 - but normal abilities in executive function
 - Eg Phineas Gage
 - Similar cases seen today – usually as part of frontotemporal dementia.

Social cognition, inhibitory control & emotion

- Orbital cortex has connections with:
 - Amygdala
 - Temporal lobe
 - Insula cortex
- Forming a circuit involved in:
 - Emotion
 - Judgement
 - Responsiveness

Social cognition, inhibitory control & emotion

- Damage to the circuit:
 - Impaired perceptions of emotions eg
 - Facial expressions
 - Tone of voice
 - Loss of valence associated with perceptions
- All leading to a form of acquired psychopathy

Social cognition, inhibitory control & emotion

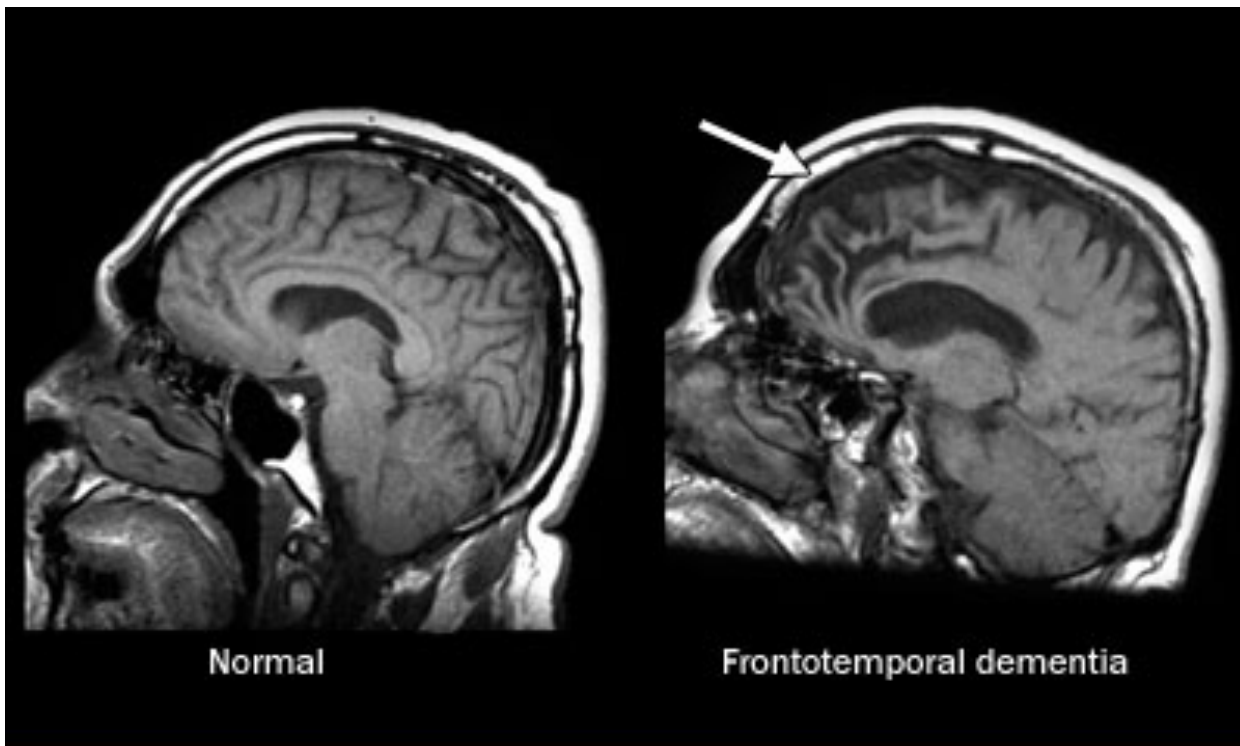
- Theory of mind
 - Functional imaging localises theory-of-mind abilities to the orbital and medial frontal cortices and superior temporal sulcus.
 - Like autistic patient, frontal patients display:
 - Lack of empathy and humour
 - Stereotyped ritualistic behaviours eg hoarding

Social cognition, inhibitory control & emotion

- Loss of inhibitory control:
 - A key feature in orbitofrontal damage
 - Tendency to react immediately , usually inappropriately to ext stimuli
- Motivation
 - Often apathetic in mesial frontal damage

Pathology of frontal lobe function

- Degenerative:
 - FTD (Pick's disease)
 - Alz. Disease (later in the course of illness)



Normal

Frontotemporal dementia

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Pathology of frontal lobe function

- Vascular
 - Bilateral ant. Cerebral artery infarction
 - SAH (ant. Communicating artery aneurysms)
- Structural
 - Major close HI – orbital, frontal and temporal most freq damaged)
 - Tumours
 - Surgical resection
 - Frontal leucotomy
- Deafferentation from basal ganglia disorders:
 - Huntington's disease
 - PD
 - PSP
 - Wilson's

Tests for the assessment of frontal executive functions

- Initiation:
 - Verbal fluency tests:
 - Letter fluency (F, A, S)
 - Category fluency (animals, fruit and veg, supermarket)
- Abstraction:
 - Proverb interpretation
 - Similarities test
 - Cognitive estimates test

Tests for the assessment of frontal executive functions

- Problem solving & decision making:
 - Formal tests:
 - Tower of London (D-KEFS)
 - IOWA or Cambridge Gambling test (CANTAB battery)
- Response inhibition and set shifting:
 - Alternating sequences
 - Go-no-go
 - Motor sequencing (Luria 3 step and alternating hand movement)
 - Formal tests:
 - Wisconsin Card Sorting Test
 - Stroop Test
 - BADS (Behavioural Assessment of Dysexecutive Syndrome)

Any questions?

