Phineas Gage

Phineas Gage was a railway worker (in the 1800s) who suffered a penetrating injury through his skull while at work.

- Modern CT-based 3D reconstructions show the tamping iron entered beneath the left eye and exited through the top of the skull.
- This trajectory caused focal damage to the *left frontal lobe* (executive function, impulse control, social behaviour).
- After injury, Gage showed marked personality change (disinhibition, social inappropriateness)
- This case demonstrates that the *frontal lobe is involved in behaviour and personality*

THE CHANGING UNDERSTANDING OF MIND AND BRAIN

		View of the mind
Ancient Egyptian, Indian, and Chinese cultures (3000-500 BC)	3000-500BC	• Viewed the *heart* as the centre of thought, emotion, and personality. They thought this because bodily signs of emotion (eg heart racing, breath changes, 'gut feelings') all made the heart seem like the organ 'doing' emotion • The brain was seen as inert because its activity can't be directly observed and because brain injury mechanisms weren't understood • These cultures viewed emotion as strongly linked to body states
Hippocrates (	400 BC	• Argued that the *brain* was the centre of the mind, which was an unpopular view at the time • Viewed mental illness as the result of natural (ie biological) forces rather than supernatural o This view positioned mental disturbance as a medical issue rather than a character-related one • Psychological disturbance was explained as the result of humoral (fluid) imbalance within the body • Historically important because he *normalised the idea that brain/body biology can cause changes in cognition and mood*
Galen	150 AD	• Proposed that the mind is mainly brain-centred because when he disrupted neural structures, behavioural changes would result • Believed that *animal spirits* (non-physical substances / life forces) passed through the body animating life
Andreas Vesalius	1540 AD	• Produced the first *highly accurate anatomical drawings of the human brain*, correcting many long-standing errors. • *Helped shift neuroscience towards empiricism*
René Descartes	1640 AD	• Proposed that reflexes are automatic mechanical responses to sensory input • Famously proposed that *the mind and body are separate* (known as **duality**) • Framed the body as a kind of machine with predictable input → output rules
Thomas Willis	1660 AD	• Rejected the idea that mental function 'lives in the ventricles of the brain', instead suggesting that cognition comes from the *cerebral cortex* • Realised that white matter acts as communication pathways linking brain regions • Proposed that different brain parts have different roles based on their structure and connections. • Helped position neural tissue organisation as the centre of the mind, rather than fluid-filled cavities

Luigi Galvani	1790 AD	• Showed that *electricity can trigger muscle contraction*, demonstrating the nerves operate like electrical wires rather than through 'spirits' or fluids • Proposed that nerves require fatty insulation (which we now know as **myelin)**
Franz Joseph Gall	1800 AD	• Argued that mental functions are localised to distinct brain regions • **Wrongly claimed** that skull shape influences brain development and therefore, personality • Despite being wrong, Gall popularised the (correct) idea that different parts of brain do different jobs

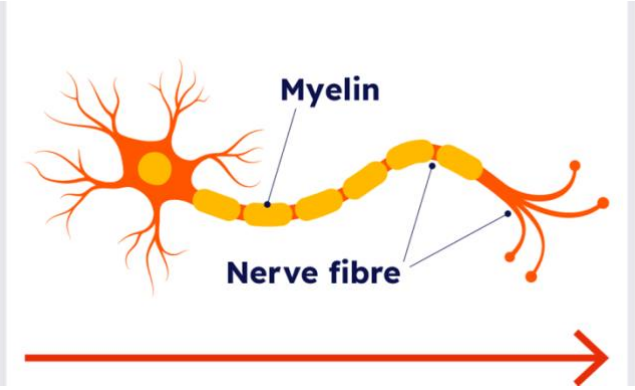
Paul Broca	1860 AD	• A doctor who begun to realise that damage to part of the left frontal lobe of the brain causes speech problems, while comprehension is intact
		• Demonstrated *hemispheric specialisation*; that the left and right hemispheres do not have the same functions
		  ○ Left hemisphere = more important for language
		  ○ Right hemisphere = more important for spatial reasoning
		• *His work helped separate language into components* (production vs comprehension)

Fritsch and Hitzig	1870 AD	• Electrically stimulated parts of the frontal cortex and found that doing so produced predictable movements • Demonstrated that the cortex is not only responsible for "thought" but also for 'action'
Egas Moniz	1940s	• Introduced prefrontal leucotomy as a treatment for psychiatric disorders by severing frontal lobe connections ○ The rationale was that disrupting maladaptive emotional/thought loops could reduce severe symptoms. • The procedure often caused short term behavioural quieting, but this did not actually fix the patients' mental illnesses, it simply blunted their emotion and behaviour
Walter Freeman	1940s-1950s	• Performed lobotomies widely, popularising them and pushing them into routine clinical use • Outcomes typically led to profound personality change, apathy, cognitive deficits, seizures, loss of independent function etc

MYELIN

Myelin is a fatty substance that the body uses to wrap around nerves, forming *sheaths*. Because myelin *does not conduct electricity*, electrical signals (action potentials) are forced to *jump between unmyelinated segments* of the nerve.

⇒ Myelination results in *rapid conduction* of signals throughout the body.



Multiple Sclerosis

MS is an *autoimmune disease* where the body's immune system mistakenly attacks and destroys myelin surrounding nerves. This results in *slowed action potential conduction*, and can result in:

- Altered sensation
- Slurred speech
- Muscle weakness / paralysis