Studying the brain: methods of inquiry

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Name of method	*Procedure*	*Notes*
Selective lesioning	Studying the behavioral consequences of planned and selective lesioning (surgically removing or damaging a structure in the brain)	Only used in animal studies
Single-cell recordings	Studying the activity of single neurons, by probing them with small microelectrodes to discover what stimulus or behavior triggers the cell's activity	Only used in animal studies
Post mortem dissection	Examining patient's brain for lesions (damaged areas) after death	Behavioral consequences must have been studied prior to the death of the patient
Exploratory neurosurgery	Examining patient's brain by electrically stimulating certain areas of the exposed brain	
Event-related potentials (ERPs)	Recording the electrical activity of the brain at the scalp, using electroencephalograms (EEGs), as it occurs in response to a stimulus or preceding a motor response ('event-related')	Gives precise information on the timing of the brain activity, but less precise information on the location (since the recording occurs at the scalp only)
Computerized axial tomography (CAT or CT)	Mapping the brain using X-ray technique	Used to scan the brain for large structural abnormalities
Positron emission tomography (PET)	Measuring brain activity using a radioactive tracer mixed with glucose; active neurons require the most glucose and will be most radioactive	Gives precise information on the location of the brain activity, but less precise information on the timing (since glucose consumption is a relatively slow process)
Functional magnetic resonance imaging (fMRI)	Measuring brain activity by recording magnetic changes resulting from oxygen consumption	Gives precise temporal and spatial information; is relatively expensive
Transcranial magnetic stimulation (TMS)	Examining the consequences of (temporary) disruptions of normal brain functioning caused by magnetic stimulation of small areas	Used to study cognitive functioning
Magnetoencephalography (MEG)	Localizing brain activity by measuring magnetic changes	Precise method used in surgical applications, alongside electrical stimulation of the exposed brain

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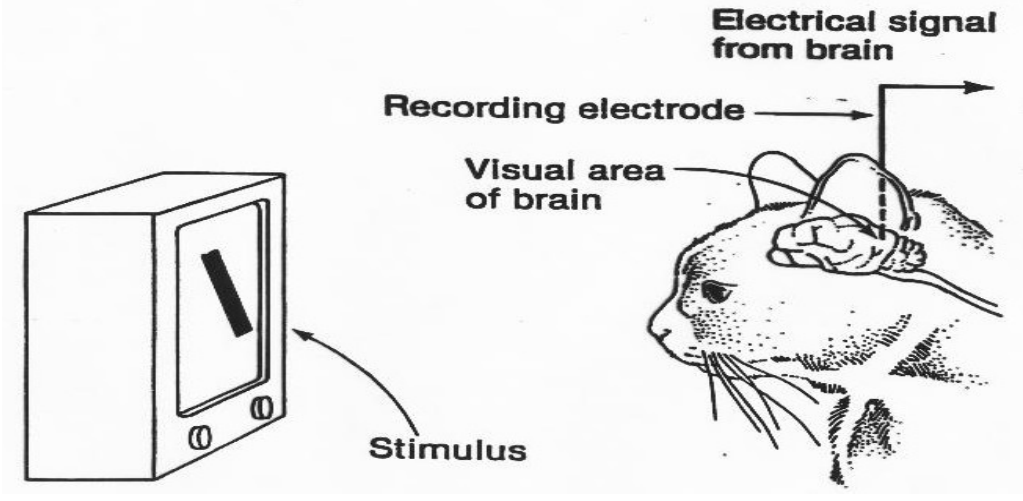

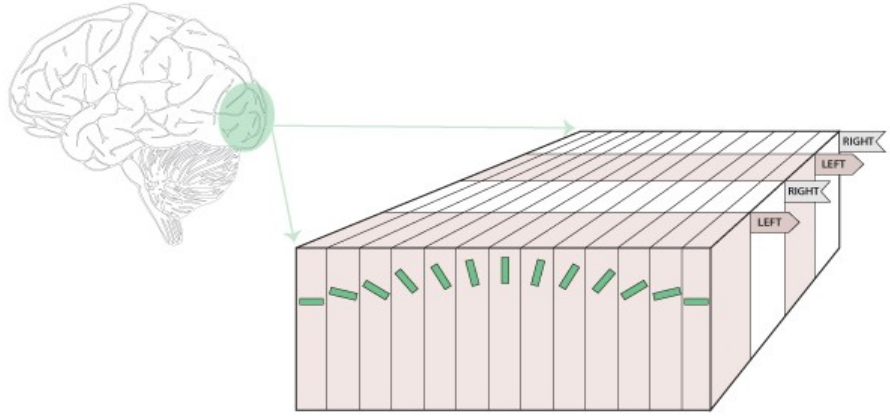

Hubel and Wiesel (1950)

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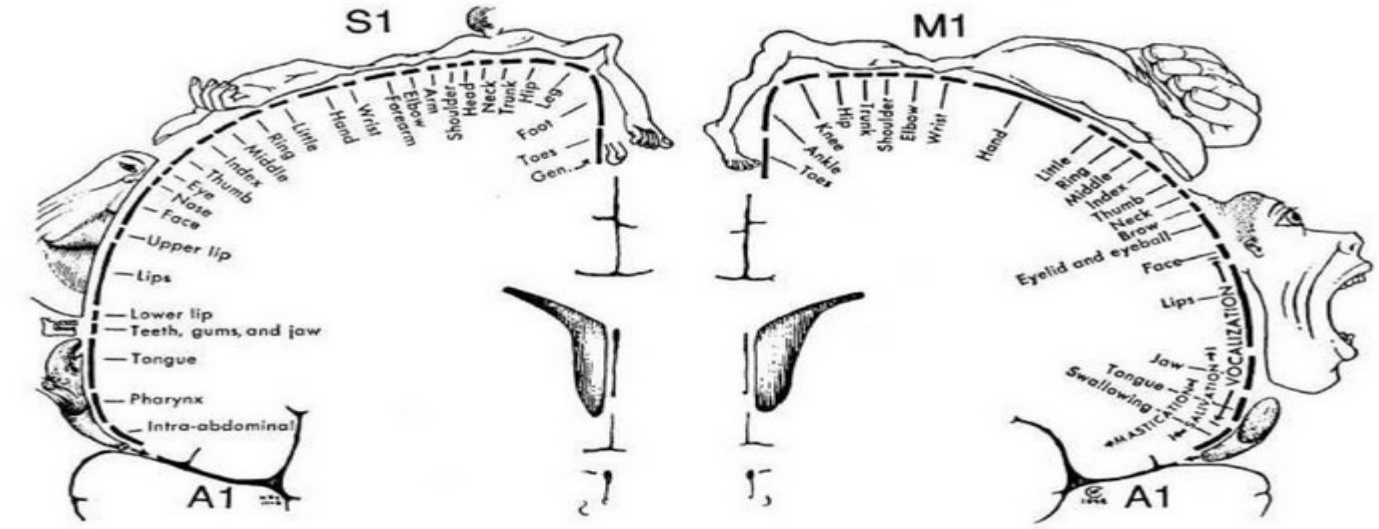
Exploratory neurosurgery	Examining patient's brain by electrically stimulating certain areas of the exposed brain



7: Cortical homunculus by Wilder Graves Penfield [174]. It represents the mapping the primary sensory (S1) and primary motor (M1) cortex. S1 lies on the posterior wall of the central sulcus (cf. post central gyrus in figure 1.6(a)) and M1 on the anterior part. These maps were established by direct electrical stimulation on patients during surgery. Primary auditory cortices (A1), left and right, are represented in the temporal lobes.

Studying the brain: methods of inquiry

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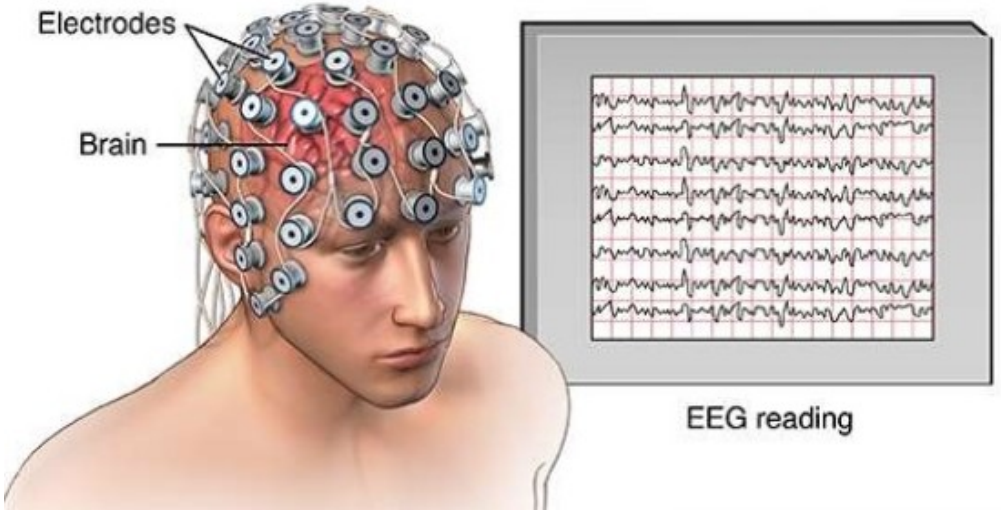
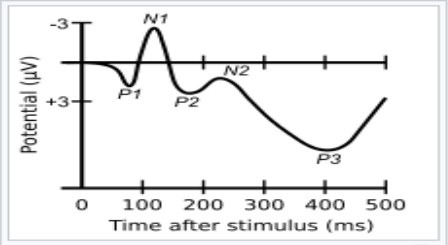
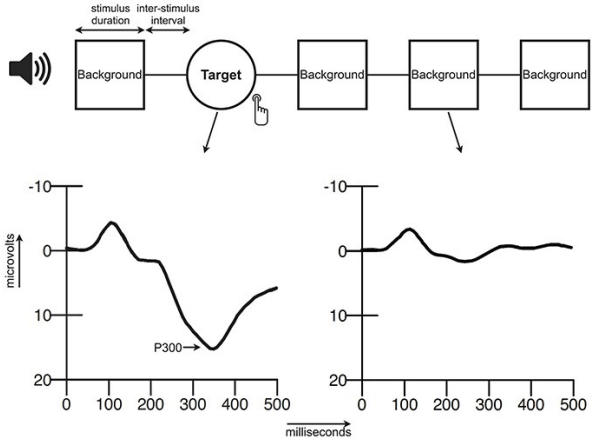




A waveform showing several ERP components, including the N100 and P300. Note that the ERP is plotted with negative voltages upward, a common, but not universal, practice in ERP research



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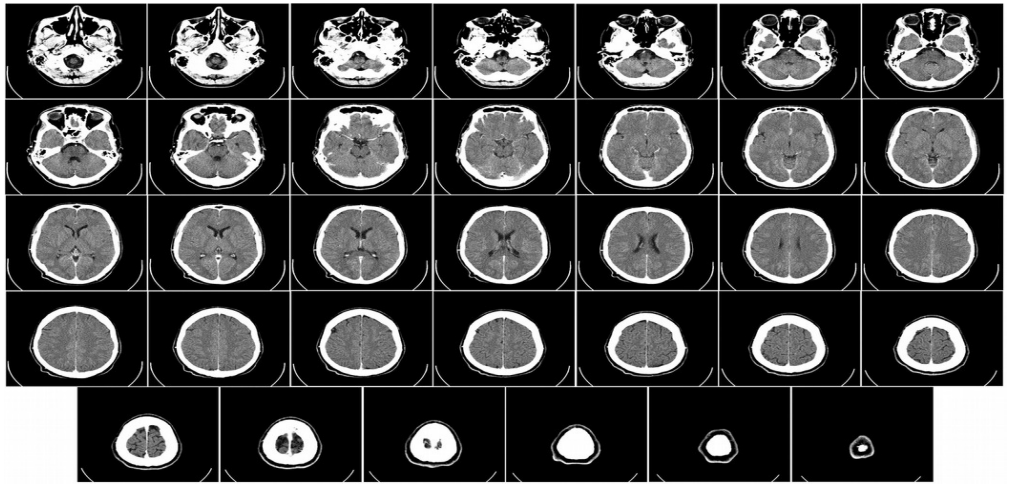

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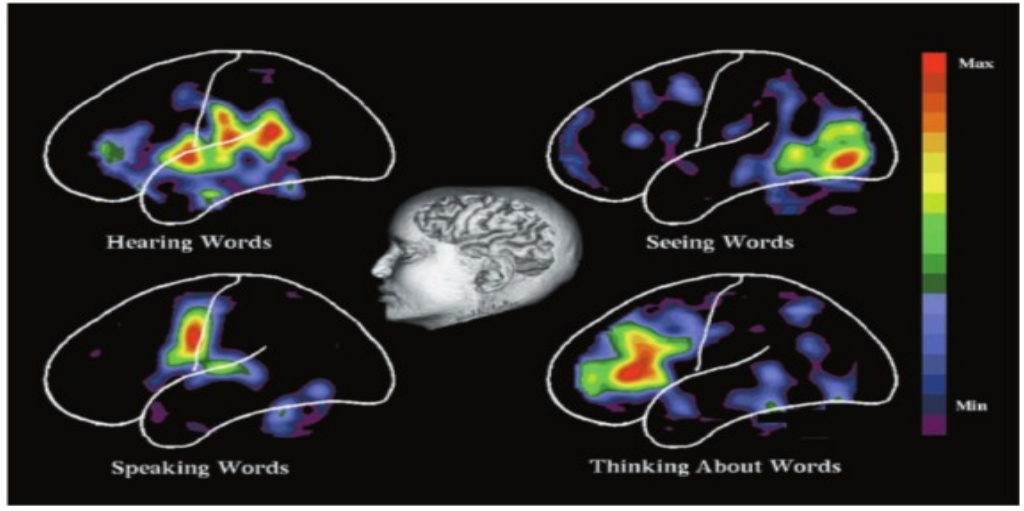

PET scans in a human subject illustrating that different areas of the brain are involved in different modes of word processing.

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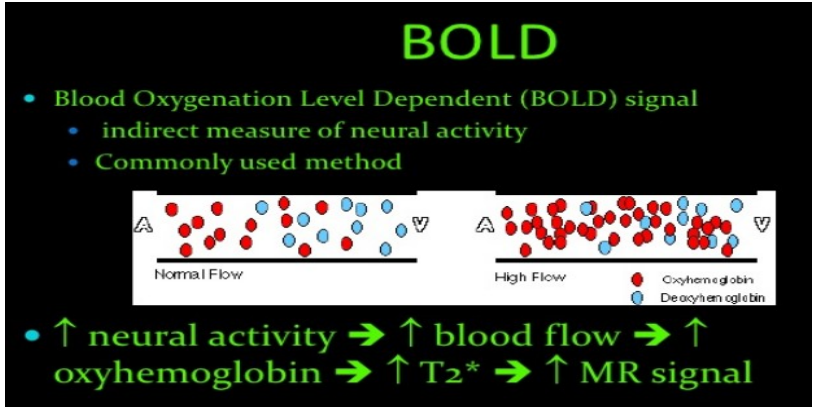

https://www.slideshare.net/ricksw78/fmri-presentation

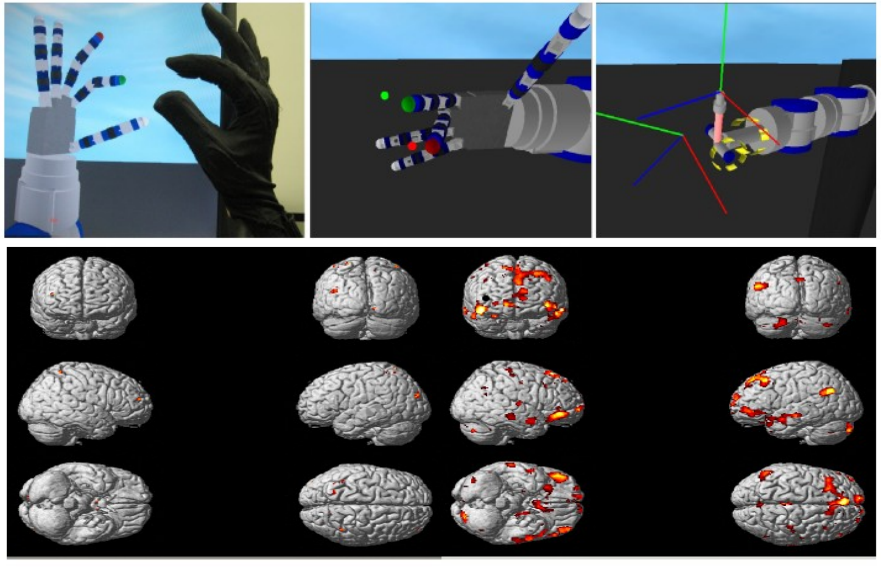

Figure 6. AN-NAN (left) and NAN-AN (right) contrasts for a single subject ($p<0.005$)

Humanoid Brain Science Erhan Oztop, Emre Ugur, Yu Shimizu, Hiroshi Imamizu, Humanoid Robotics and Neuroscience: Science, Engineering and Society, 29

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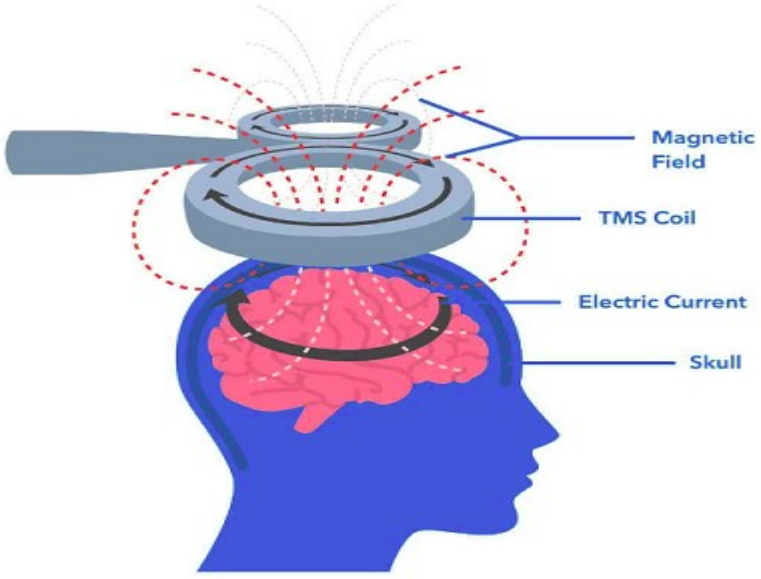

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Magnetoencephalography (MEG)	Localizing brain activity by measuring magnetic changes	Precise method used in surgical applications, alongside electrical stimulation of the exposed brain