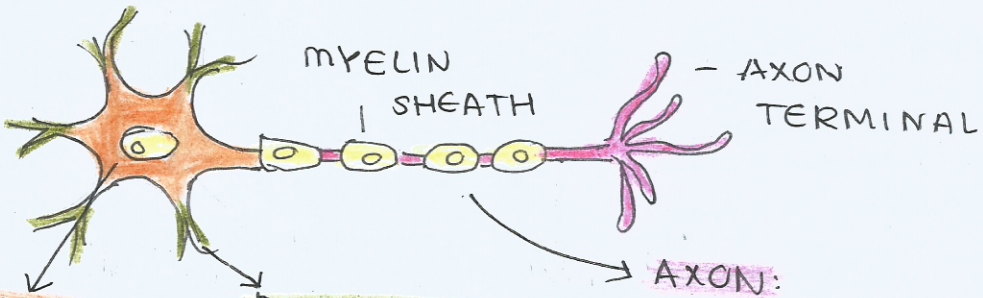
NEUROTRANSMITTERS AND BEHAVIOUR

Nervous system processes

Nervous system is a system neurons.

Neuron



SOMA:
- The cell body

DENDRITES:
- extruding filaments from the soma

AXON:
- Transmits signals to other neurons.

Dendrites and soma receive the signals from other neurons.

Synapse:

- It is a structure that connects two neurons.
- Axon of one neuron approaches the dendrite/soma of another neuron → synapse is formed.

Threshold of excitation

- It is the level of excitation that is needed for a neuron to react properly to a stimulus. If the sum of excitation exceeds this threshold, the neuron generates a brief pulse called action potential.

Neurotransmitters

- They are chemical messengers.
- constantly synthesized in the neuron
- stored in the axon terminal.

The electrical pulse reaches the end of axon

↓

at the synaptic gap the mechanism of transmission becomes chemical.

When the action potential reaches the end of an axon,

↓

A neurotransmitter is released into the synaptic gap.

When the neurotransmitter is present in the synaptic gap, it can either

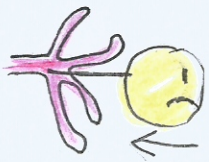
get metabolized

→ gets destroyed

neurotransmitter

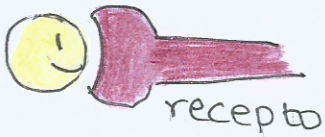
reuptake

→ gets pulled back into the axon terminal



post-synaptic membrane

→ reach the post-synaptic membrane and bind to the receptors on its surface



receptor

(TWO) TYPES OF NEUROTRANSMITTERS

Excitatory

→ They allow the impulse to pass the synapse.

→ produces stimulating effects

Inhibitory

→ They prevent the impulse to cross the synapse.

→ produces calming effects

When neurotransmitters are out of their optimal ranges, they can cause mental disorders.

These neurotransmitters are affected by

- Agonists
- Antagonists

Agonists: enhance the action of a neurotransmitter

Antagonists: counteract a neurotransmitter (prevent a signal from being passed further.

SSRIs → Selective serotonin reuptake inhibitors

- They block the reuptake of the serotonin from the synaptic gap.
- This increases the concentration of serotonin in the synapse.

EFFECT OF SEROTONIN ON PROSOCIAL BEHAVIOUR

Crockett et al (2010)

Aim: To investigate the effect of serotonin on prosocial behaviour.

SEROTONIN - Inhibitory neurotransmitter
- Helps in regulating sleep cycles and
- sustaining stable mood.

ZZZ....

Sample: 30 healthy subjects (mean age 26)

Repeated measures design with 2 conditions:

condition one

- participants were given a dose of citalopram (ssRI).

condition two

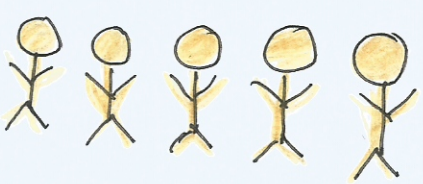
- participants were given a placebo (a harmless substance with no effect)

Procedure:

- Participants were given a series of moral dilemmas:
- They were asked to choose between a

Utilitarian outcome

→ saving 5 lives.



Arvesive harmful actions

Personal

pushing a man off the bridge to stop a train & save 5 people

Impersonal

diverting the track by pulling a level to save 5 but kill 1.

Results: The responses in the impersonal version were unaffected by citalopram.

condition I

→ people were less likely to push the man off the bridge in the personal scenario.

Conclusion:

-Serotonin reduces acceptability of personal harm and promotes pro-social behaviour.

Limitation:

- The citalopram intake caused nausea in the participants.
- The participants could have figured if they were on citalopram or not which might have affected their answers.

EFFECT OF DOPAMINE ON ROMANTIC LOVE - Fisher, Aron and Brown (2005)

Aim: To study the neural mechanisms of romantic love.

DOPAMINE: - exitatory neurotransmitter
- involved in motivation
- pleasure center
- regulating emotional response

Sample: 10 men and 7 women - intensly in love but not with each other.

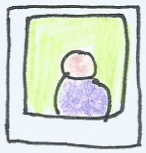
- Mean age: 21 years
- Mean duration of being in love: 7 months

Procedure:

- Participants were placed inside a fMRI and were asked to look at photographs of their loved ones while their brains were being scanned.

Four stages: (Repeated 6 six time → 720 seconds total)

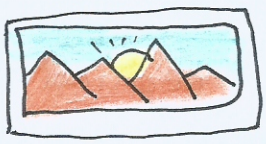
1. For 30 seconds each participant viewed a photograph of his or her beloved person.



2. Participants were given a 40-second filler activity which was to count back from a given number. 100, 99, 98...

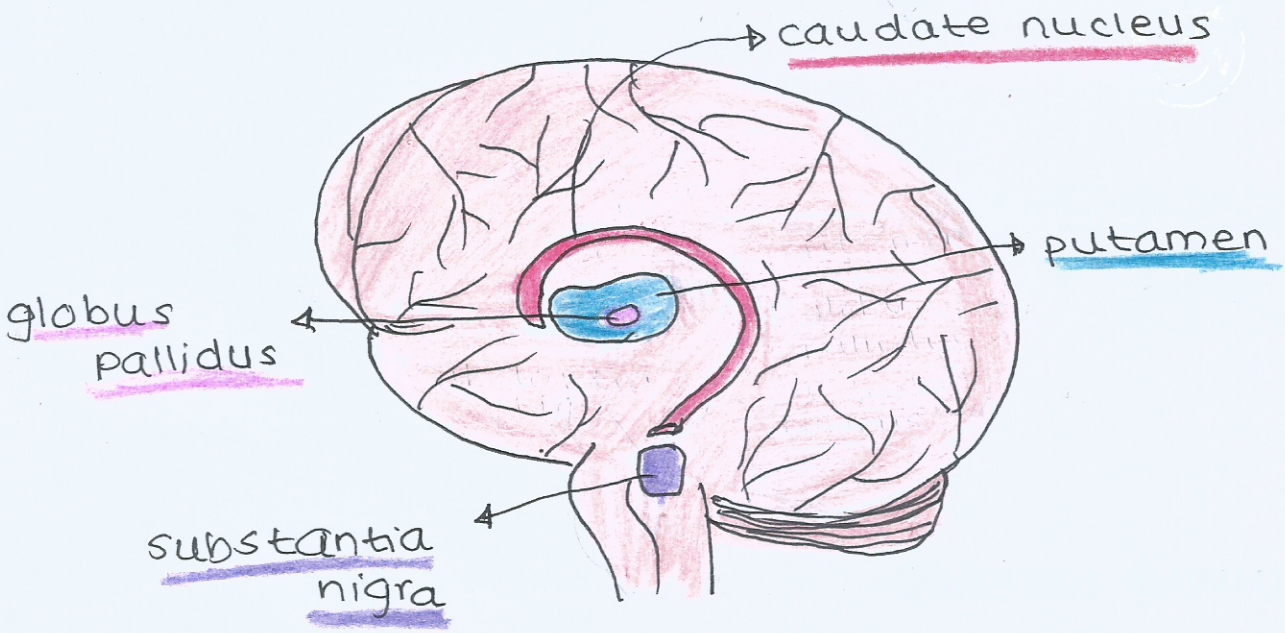
3. For 30 seconds more, participants viewed a photograph of an emotionally neutral acquaintance.

4. Final stage - 20 seconds of counting back from a number. 50, 49....



Results:

- Specific parts of the brain were activated when the pictures of their loved ones were shown.
- Caudate nucleus and Ventral Tegmental Area were primarily activated.
  - They are rich in dopamine and are a key part of the Dopaminergic pathway.
  - It is a system that generates and transmits dopamine. It also increases dopamine related activity in the brain.



THE ROLE OF SEROTONIN IN DEPRESSION

Low levels of serotonin in the brain play a casual role in developing depression.

Clinical trials included 2 experimental groups.

Group-1 : Given drugs that affect the levels of serotonin.

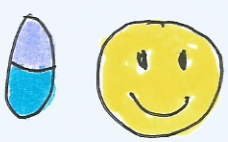
Group-2 : Given a placebo which had no effect on the serotonin level.

Results: In group-1 the drugs (SSRIs) lead to a reduction of symptoms of depression.

Limitations:

- The drugs affect neurotransmitters immidiately but the behavioural affects take time.
- Not all patients benefit from drugs. The link between serotonin and depression isn't universal.

- Depression was linked to 5-HTT gene which is a serotonin transporter gene.
- This gene determines a person's vunerability to developing depression.



5HTT

THE ROLE OF DOPAMINE IN PARKINSON'S DISEASE Freed et al (2001)

Aim: To study the role of dopamine in people with parkinson's disease.

PARKINSON'S DISEASE: It is a degenerative disorder that affects the motor functions of the nervous system.

Sample: 40 patients (34-57 years old) who had severe parkinson's disease for the mean duration of 14 years.

Procedure: Randomly divided into 2 groups

GROUP-1 (Experimental)	GROUP-2 (control group)
• transplant of nerve cells	• sham surgery

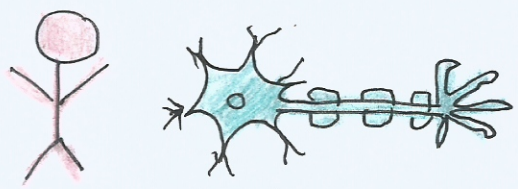
▷ In the 1st group, nerve tissues that contained dopamine producing neurons were transplanted into their putamen.

▷ These nerve tissues were taken from embryos who were aborted 7-8 weeks after conception.

▷ Putamen → part of limbic system that helps in movement regulation.

▷ In the 2nd group, holes were drilled in the skull but the dura wasn't penetrated.

▷ The surgeries for both groups were identical otherwise.



Results:

- PET scans showed increase growth of dopamine-producing cells in the putamen.
- Reduction of symptoms by 28% in the transplant group. (only in young patients - 60 or younger)
- No improvements in the older patients (aged over 60)

↑ DOPAMINE (young) ↓ SYMPTOMS

DOPAMINE ↑ (old) ✗ NO RESULTS

Conclusion:

- The transplant of domapine producing neurons resulted in some improvement in the young patients and not the older ones.
- Less response to treatment in the older patients might be because of lower neuroplasticity of the brain.

Protocols followed:

- The consent form describing the risks and benefits were approved by the ethics commitee.
- Written consent form was used for the women who donated the fetal tissues from abortions.
- Clinical observations and brain scans were followed up for a year.