

What is the Nervous System

the nervous system includes:

- brain
- spinal cord
- all connection between brain spinal cord and all other organs in the body
- all the connections between the organs back to the spinal cord and brain

The Nervous system is built like a continuous loop of communication between the brain spinal cord and body and body spinal cord and brain. In fact we really can't even separate them, it's one continuous loop

The nervous system governs all other biological systems of the body and it's also influenced by those other biological systems

The nervous system made up of trillions cells nerve cells that are called neurons.

Neurons weren't touching another ones and separated by little gaps called synapses.

synapses are places one neuron vomited and detects the chemicals into the next neuron and then passes electricity down its length to the next nerve cell and so forth

The way to think about your body and your thoughts and your mind is that you are a flow of electricity

- depending on which nerve cells are active at a given moment
- you're a flow of electricity
- the language of the nervous system is just electricity

Our experiences our memories and everything is sort of like

- playing the keys on a piano in a particular order and with a particular intensity (song)
- given song is analogous to a given experience
- special key is not really the song , it's just one component of the song (key-> neuron, song->experience)

hippocampus : brain area involved in memory

- memories stored as patterns of electricity and neurons
- when these patterns repeated give you sense that you're experiencing the thing again

Deja Vu

Deja Vu : the sense that what you're experiencing is so familiar and like something that you've experienced previously.

Deja Vu is merely that the neurons that were active in one circumstance are now becoming active in the same circumstance again .

How War, Guns & Soap Shaped Our Understanding of the Brain

warfare :

- new bullets make a very small hole in brain at very discrete and specific location
- with advancement in the cleaning of wounds many more people were surviving

Jennifer Aniston Neurons

Nature journal paper in early 2000s : in a perfectly healthy human being there was a neuron that would become electrically active only when the person viewed the picture of Jennifer Aniston

Sensations

our brain is really a map of our experience

The nervous system really does five or six things

1. sensation :

- a non-negotiable element of the nervous system (e.g. neurons in the eye that perceive certain colors of light)
- entire experience of life is filtered by these sensory receptors
- there are many species on this planet that are perceiving things that we will never perceive unless we apply technology (e.g. infrared vision)

Magnetic Sensing & Mating

there are turtles and certain species of birds that migrate long distances that can detect magnetic fields because they have neurons for it.

Perceptions & The Spotlight of Attention

2. Perceptions:

- is our ability to take what we're sensing and focus on it and make sense of it to explore it to remember it.
- is under the control of your attention and the way to think about attention
- it's like a spotlight except it's not one spotlight you actually have two attentional spotlights

Multi-Tasking Is Real

In old world primates of which humans are we are able to do what's called covert attention

covert attention :

- one spotlight of attention on (e.g. we're reading)
- a second spotlight of attention on (e.g. we're eating)

we can split attention into two location or one particular location

we can dilate your attention kind of like making a spotlight more diffuse or you can make it more concentrated

Attention is absolutely under your control in particular when you're rested

Bottom-Up vs. Top-Down Control of Behavior

we have something in our nervous system which is sort of like a two-way street.

That two-way street is a communication between the aspects of our nervous system that are reflexive and the aspects of our nervous system that are deliberate

reflexive action -> bottom-up processing (e.g. walking) bottom-up processing means:

- that information is flowing in through your senses regardless of what you're perceiving
- that information is flowing up and it's directing your activity
- feel easy

deliberate action, perceptions or thoughts -> top-down processing (e.g. a car in front of you while walking)

top-down processing:

- require some effort , some focus and some strain
- decide to focus your attention and energy on anything you want

Focusing the Mind

The nervous system basically wired up

- to be able to do most things easily without much metabolic demand without consuming much energy
- but the moment trying do something very specific you're going to feel a sort of mental friction and challenging
 - sensations -> perceptions -> slash emotion

Emotions + The Chemicals of Emotions

emotions and feelings are the product of the nervous system

neuromodulators : chemicals released by neurons and has a a very profound influence on our emotional states.

they bias which neurons are likely to be active and which ones are likely to be inactive

- dopamine : the molecule of reward or joy

- upbeat mood in when released in appropriate amounts in the brain
- a molecule of motivation toward things that are outside us (e.g. when we accomplish something in route to a goal and we feel more motivation)
- extreme example -> mania : when somebody relentlessly in pursuit of external things like money
- the reason is that it makes certain neurons (neural circuits) more active and others less active
- serotonin : tends to make us feel really good with what we have
- acetylcholine
- epinephrine

Antidepressants

neuromodulators can exist in normal levels low levels high levels.

Antidepressants (antipsychotics) :

- discovered in the 1950s 60s and 70s
- compounds chemicals that can increase or decrease neuromodulators
- the problem especially in the 1950s and 60s : if they increase or decrease serotonin (for example) they would also increase or decrease other neuromodulator or chemical
 - reason -> : all chemical in particular the neuromodulators have a lot of receptors on different organs. so neuromodulators can have different effects on different aspects of our biology (e.g. dopamine receptor on the heart -> beat faster)
 - examples: sexual side effects, blunt appetite, blunt motivation

feelings and emotions are contextual (depends on cultures) feelings and emotions are somewhat reflexive (without deliberate thought)

Thoughts & Thought Control

Thoughts :

- like perceptions except not just on what's happening in the present
- can be both reflexive and deliberate

Actions

actions or behaviors :

- the most important aspect to our nervous system
 - the only thing that are going to create any fossil record of our existence
 - so much of our nervous system is devoted to converting sensation perceptions feelings and thoughts into actions

creating movement in nervous system occurs occurs through some very simple pathways

- the reflexive pathway -> called central pattern generators (e.g. walking)

- when we decide to move in deliberate way -> more attention -> top-down processing in brain (forebrain) -> control central pattern generators

movement can be both reflexive and deliberate

when you do something deliberately, you pay attention and bring perception to an analysis of three things (DPO):

- duration
- path : what you should be doing
- outcome

when you engage in something deliberately and DPO (that is challenging)

- you start to recruit neuromodulators which released from particular areas of your brain
- these neuromodulators cueing to your nervous system something's different

How We Control Our Impulses

Impulses (trigger) -> suppressing your behavior through top-down processing (forebrain) -> feel like agitation and stress (because it's accompanied by the release of a neuromodulator called norepinephrine)

norepinephrine : which in the body we call adrenaline

young children or people with damage to certain areas of the frontal lobes -> don't have the forebrain circuitry to engage in this top-down processing

alcohol also can turn off the forebrain and make it harder to top down processing

limbic friction : * when :low-level tremor , agitation

* that 'gap' between the logical cerebral (frontal) cortex and the emotional limbic system – between wanting to do a thing, and actually doing that thing. <https://altis.world/center-news/limbic-friction/>
limbic: area of brain involved in more primitive reflexive responses (limbic system)

Neuroplasticity: The Holy Grail of Neuroscience

That agitation (during top-down processing) is the entry point to neural plasticity

neural plasticity:

- a process by which neurons can change their connections
- in the way that you can go from things being very challenging and deliberate requiring a lot of effort and strain to them being reflexive
- typically positive or adaptive (not plasticity by brain damage)
- people want self-directed plasticity mostly

brain is incredibly plastic from birth to age 25

- they can learn all sorts of things passively without hard work and hard focus

But at adult age when you want to change neural circuitry, ask 2 important questions:

1. what particular aspect of the nervous system to change (emotions or perceptions or sensations) and which one available to change
2. how ? : the structure of a regimen to engage neuroplasticity.
 - governed by how awake or how sleepy we are

we can direct our own neural changes and decide that we want to change our brain (brain can change itself too) * the same can't be for other body organs

young brain can change very dramatically

- born blind from birth can use the area of brain that normally be used for visualizing objects for brail reading

The Portal to Neuroplasticity

plasticity in the adult human nervous system is gated :

- it is controlled by neuromodulators
- neuromodulators allow brief period of time -> whatever information whatever thing we're sensing or perceiving or thinking ... -> literally be mapped in the brain for easier experience
- has a dark side and a positive side

dark side :

- easy to get neuroplasticity as an adult through traumatic or terrible or challenging experiences
- reason : two set neuromodulators
 - epinephrine :
 - feel more alert and agitated
 - associated with bad circumstances
 - acetylcholine :
 - create a even more intense and focused perceptual spotlight
 - like a highlighter
 - coming from an area of the forebrain
 - marking the neurons that are particularly active with epinephrine alertness
 - strengthening those neurons and the synapses
 - to become more likely active in future without thinking about it

dirty secret of neuroplasticity:

- no neuroplasticity occurs during
 - you're trying to learn
 - the terrible or the great event
 - ...
- the neuroplasticity (strengthening of the synapses or addition new neuron in some case) occurs when:
 - sleep or
 - non-sleep deep rest

Accelerating Learning in Sleep

2 research for better learning

- 20 min deep rest
- background bell in awake and deep sleep

neuroplasticity not just in changing your nervous system to add something new but to also get rid of things that you don't like

The Pillar of Plasticity

neuroplasticity is a two-phase process

- alert and focused
- deep sleep state

The autonomic nervous system governs transition between these 2 phase.

- it works like a seesaw

Leveraging Ultradian Cycles & Self Experimentation

ultradian rhythms : a recurrent period or cycle repeated throughout a 24-hour day.

circadian rhythms: complete one cycle daily

the 90 minute rhythm is the most important ultradian rhythms for our discussion.

our sleep is broken up into 90 minute segments

90 minute cycles also occurs in wakefulness.

all these cycles governed by this seesaw of alertness to calmness (automatic nervous system).