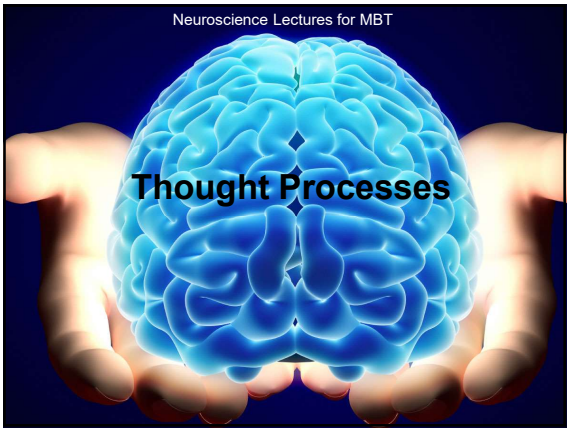
Neuroscience Lectures for MBT



Thought Processes

- Voluntary attention
- Reflexive attention

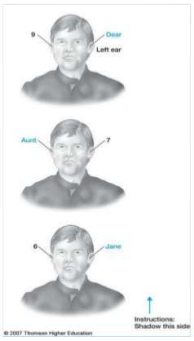
'Attention is … The taking possession by the mind … of one out of what seem several simultaneous possible objects or trains of thought.'
William James, 1890

Dichotic listening task

Index

1. Attention
2. Working memory
3. Learning and memory
4. Mental time travel
5. Memory (re) consolidation
6. Decision-making
7. Reward and motivation
8. Language processing
9. Executive function

COCKTAIL PARTY EFFECT

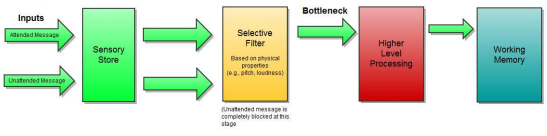


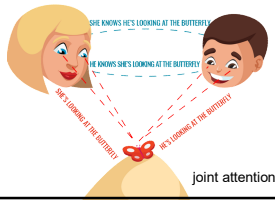
- Introduced by Cherry (1953), this theory focuses on the individual's ability to attend to a single talker among a mixture of conversations and background noises, ignoring other conversations.
- The experiment was conducted on dichotic listening task.
- The subjects were asked to listen to two different messages from a single loudspeaker at the same time and try to separate them; and only repeat one message and not the other, known as '**shadowing**' task.
- His work revealed that the ability to separate sounds from background noise is based on the characteristics of the sound, such as gender of the speaker, direction from which the sound is coming, the pitch or the speaking speed.
- When the messages were similar in characteristics, subjects were unable to complete the task successfully.

1. Attention

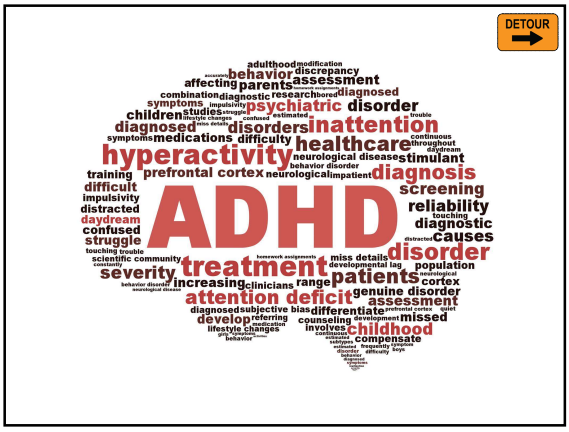
This is a good way to get people's attention. No matter what you're doing, you're going to stop and read this blinking image.

Broadbent's Filter Model



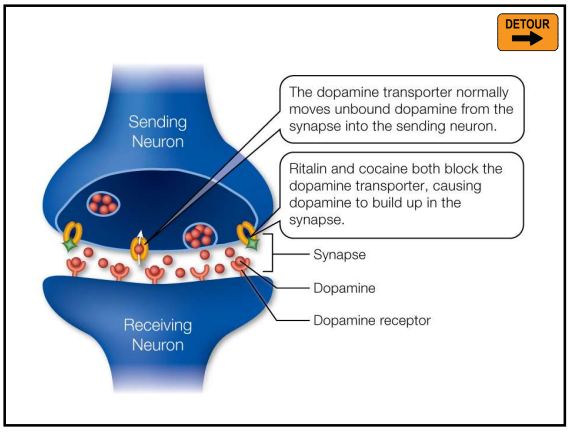


joint attention



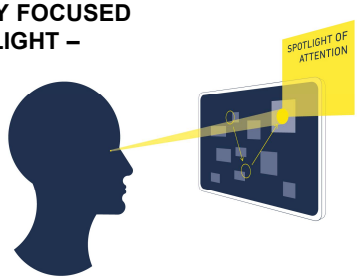
«inattentional blindness»
«inattentional deafness»

1999

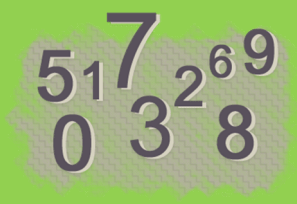


1. Attention

TAKE HOME MESSAGE:
– ATTENTION IS A NARROWLY FOCUSED SPOTLIGHT –

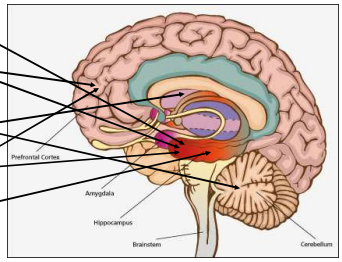


2. Working memory



'Human thought processes are underpinned by an integrated system for temporarily storing and manipulating information.'
Alan Baddeley, 2003

- Declarative memory
(London is the capital of UK)
- Episodic memory
(childhood experiences, or what we had for breakfast yesterday)
- Procedural memory
(riding a bike, driving a car)
- Semantic memory
(meanings and concepts)
- Spatial memory
(our environment and the relationship of objects and landmarks within it)



Working Memory

1974 Alan Baddeley and Graham Hitch

system for temporary storage and initial management of information, creating a functional link bewtween sesory perception and controlled action

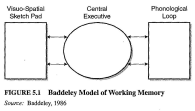
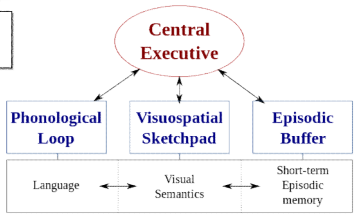
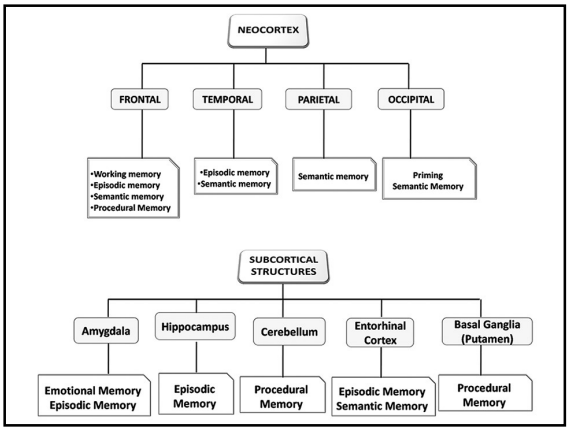
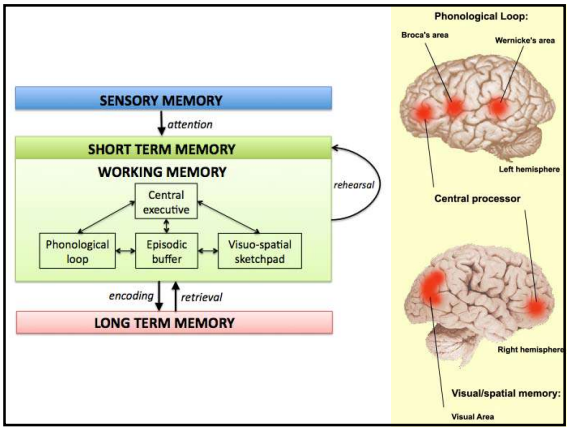


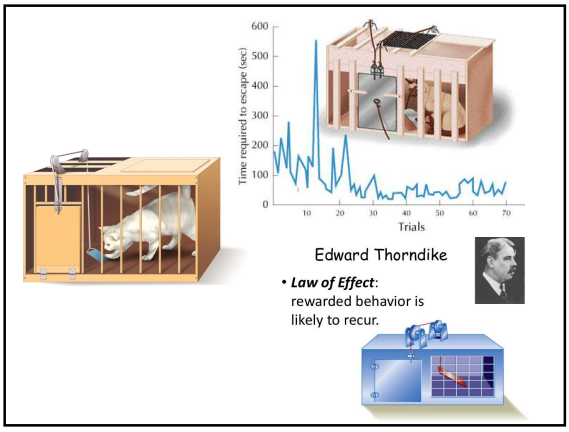
FIGURE 5.1 Baddeley Model of Working Memory
Source: Baddeley, 1986





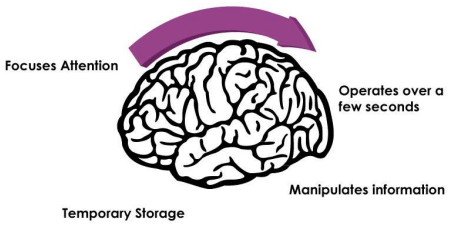


'There is a finite span of immediate memory and this span is about seven items in length.'
George Miller, 1956



2. Working memory

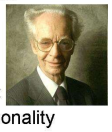
TAKE HOME MESSAGE:
– Limited amounts of information stored for a limited time –



Operant conditioning

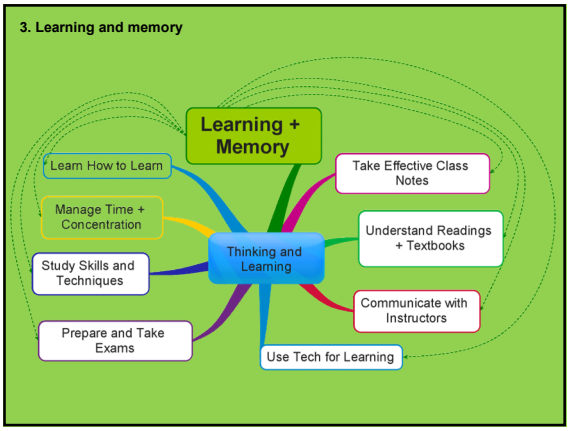
B.F. Skinner
Science and Human Behavior (1953)

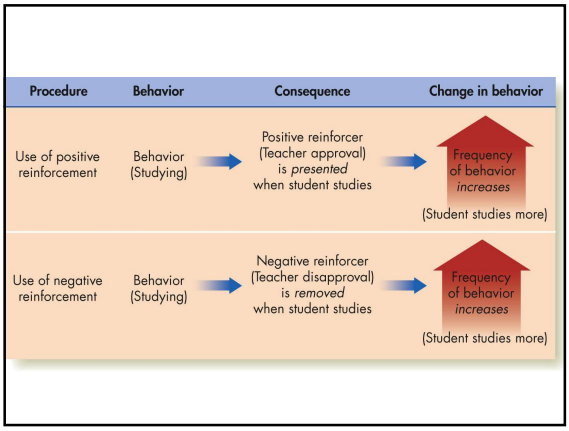
- Human behavior Under Stimulus Control
  - Source of Doctrine of Situationism
- Important Variables
  - Reinforcement History
  - Discriminative Stimuli
  - Contingencies of Reinforcement
- Sources of Complexity of Personality
  - Complexity of Stimulus Conditions
  - Complexity of Reinforcement History



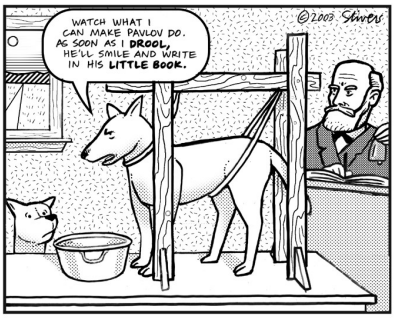
'Behaviour is shaped and maintained by its consequences.'
B.F. Skinner, 1971

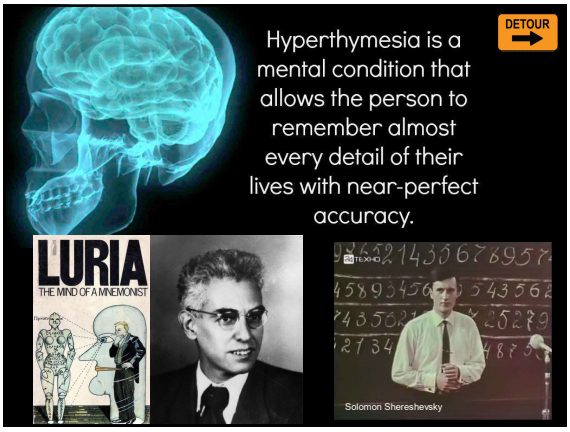
3. Learning and memory





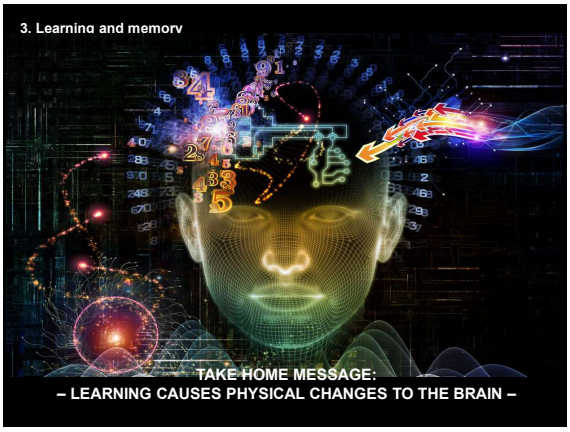
Classical conditioning





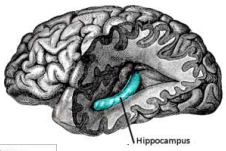
DISULFIRAM

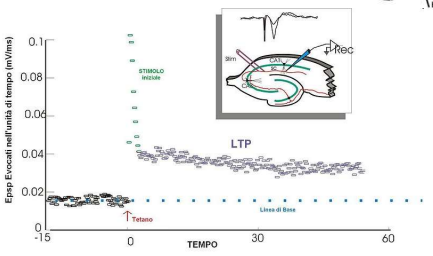
Disulfiram is used to ensure Abstinence in the Treatment of Alcohol Dependence. Its Main effect is to Produce a rapid & Violently Unpleasant Reaction in a Person who ingests even a Small amount of alcohol While Taking Disulfiram.



Cells that fire together, wire together

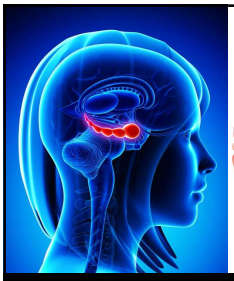
Let us assume that the persistence or repetition of a reverberatory activity (or "trace") tends to induce lasting cellular changes that add to its stability... When an axon of cell *A* is near enough to excite a cell *B* and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that *A*'s efficiency, as one of the cells firing *B*, is increased.



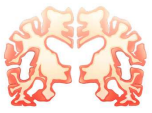


Memory, wrote William Blake, enables us to 'traverse times and spaces far remote'.

'You don't need mental time travel to remember a chemical formula … But you can't remember events from your past, or anticipate your future, without it.'
Endel Tulving, 2003



Healthy Brain



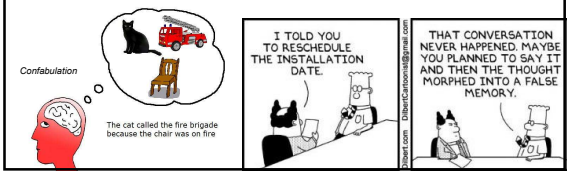
Alzheimer's Disease

1. Anterograde deficits are more severe
2. Episodic memories are more affected than semantic memories
3. Patients cannot time travel to the past or future

Reconstructive Memory

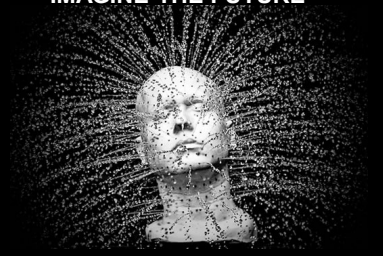
- Bartlett distinguished between reproductive and reconstructive memory
- Reproductive memory: A highly accurate, verbatim recording of an event
- Reconstructive Memory: Remembering by combining elements of experience with existing knowledge

«One's memory of an event reflects a blend of information … encoded at the time it occurred, plus inferences based on knowledge, expectations, beliefs and attitudes.»
Bartlett, «Remembering»



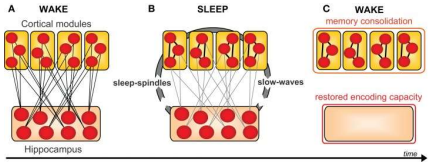
4. Mental time travel

TAKE HOME MESSAGE:
– MEMORY ENABLES US TO RECALL THE PAST AND IMAGINE THE FUTURE –



5. Memory (re) consolidation

'The interval of a single night will greatly increase the strength of the memory.'
Quintilian, c. AD 95



Dyssomnia

DETOUR

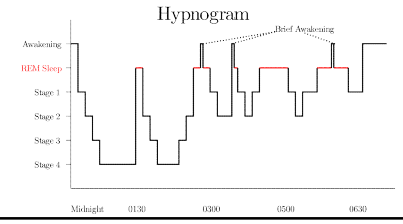
- **Dyssomnias are sleep disorders characterized by insomnia, excessive sleepiness, or abnormal sleep-wake timing**

- **Intrinsic**
- **Extrinsic**
- **Circadian**

Sleep is:
Physiological restoration
Active process

Activities/Phases:
Non-REM (early)
REM (late)

Non-rapid Eye Movement (NREM)
Stage 1: transition
5% total time
Stage 2: 50% total time
Stages 3 and **4**: slow-wave sleep
10-20% total time
Restoring sleep
Rapid Eye Movement (REM)
20-25% total time



DETOUR

Intrinsic Dyssomnia

DETOUR

- Psychophysiological insomnia
- Sleep state misperception
- Idiopathic insomnia
- Narcolepsy
- Hypersomnia
  - Recurrent, idiopathic, post-traumatic
- Restless legs syndrome
- Obstructive sleep apnea syndrome
- Central sleep apnea syndrome
- Central alveolar hypoventilation syndrome
- Periodic limb movement disorder
- Intrinsic sleep disorder NOS

DETOUR

Sleep cycle & Architecture

- Healthy persons: NREM1, then NREM 2, 3, 4, 3, 2, and then REM
- Cycles repeat every 90-120 minuti
- Entire cycle repeated 3-4/notte
- NREM 3 e 4: more prominent during the first half of the night, then decreases
- REM: the opposite

Extrinsic Dyssomnia

DETOUR

- Inadequate sleep hygiene
- Environmental sleep disorder
- Altitude insomnia
- Adjustment sleep disorder
- Insufficient sleep syndrome
- Limit-setting sleep disorder
- Sleep-onset association disorder
- Food allergy insomnia
- Nocturnal eating (drinking) syndrome
- Hypnotic-dependent sleep disorder
- Stimulant-dependent sleep disorder
- Alcohol-dependent sleep disorder
- Toxin-induced sleep disorder
- Extrinsic sleep disorder NOS

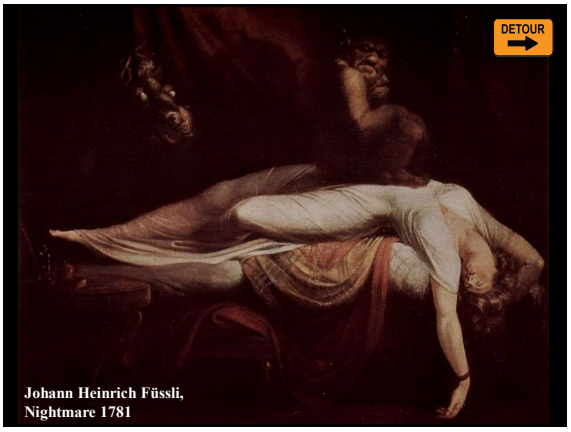
Circadian Dyssomnia

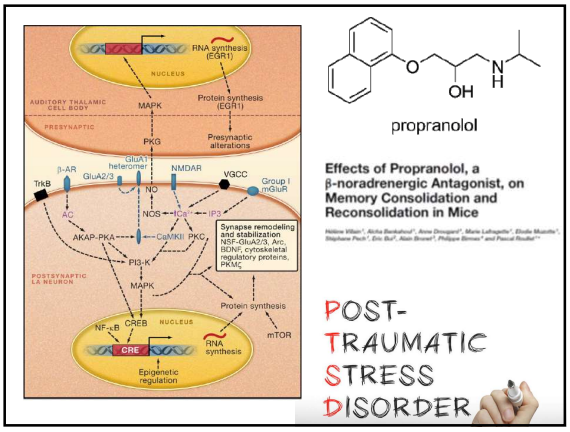
DETOUR

- Time zone change (jet lag) syndrome
- Shift work sleep disorder
- Irregular sleep-wake pattern
- Delayed sleep phase syndrome
- Advanced sleep phase syndrome
- Non-24-hour sleep-wake disorder
- Circadian rhythm sleep disorder NOS
- Shifts with age (adolescent or elderly)

DETOUR

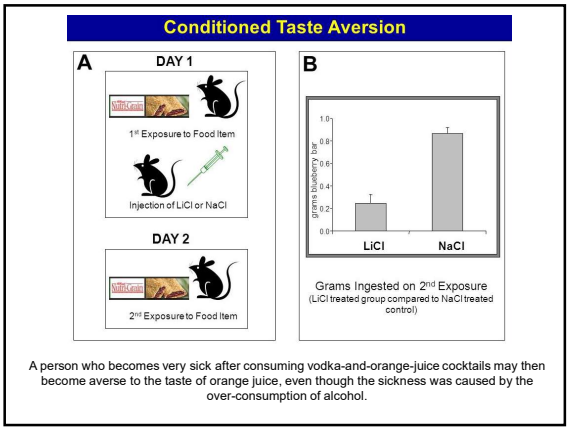
- **Parasomnias NOS**
  - Sleep bruxism (tooth grinding)
  - Sleep enuresis (bed-wetting)
  - Sleep-related abnormal swallowing syndrome
  - Nocturnal paroxysmal dystonia
  - Sudden unexplained nocturnal death syndrome
  - Primary snoring
  - Infant sleep apnea
  - Congenital central hypoventilation syndrome
  - Sudden infant death syndrome
  - Benign neonatal sleep myoclonus
  - Other parasomnia NOS





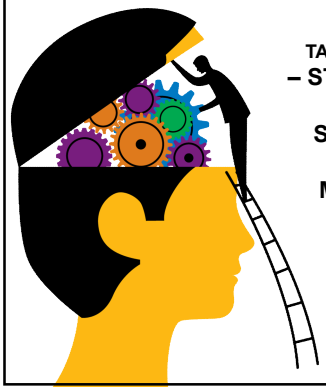
DETOUR

- **Arousal disorders:**
  - Confusional arousals
  - Sleepwalking
  - Sleep terrors
- **Sleep-wake transition disorders:**
  - Rhythmic movement disorder
  - Sleep starts
  - Sleep talking
  - Nocturnal leg cramps
- **Parasomnias usually associated with REM sleep:**
  - Nightmares
  - Sleep paralysis
  - Impaired sleep-related penile erections
  - Sleep-related painful erections
  - REM sleep-related sinus arrest REM sleep behavior

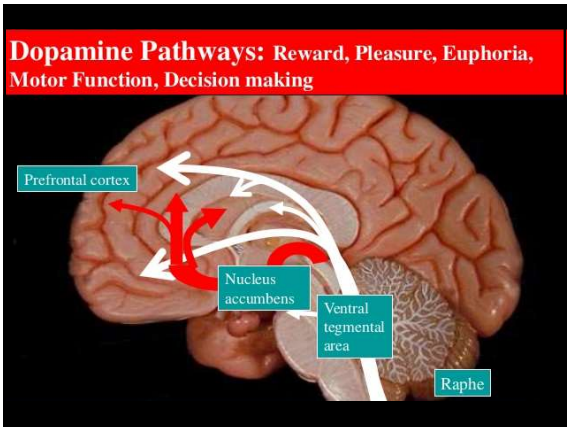


A person who becomes very sick after consuming vodka-and-orange-juice cocktails may then become averse to the taste of orange juice, even though the sickness was caused by the over-consumption of alcohol.

5. Memory (re) consolidation

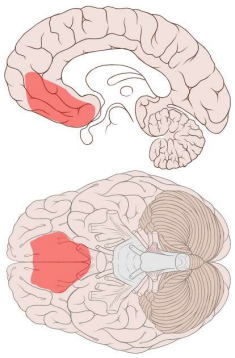


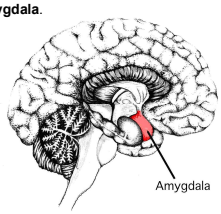
TAKE HOME MESSAGE:
– STORED MEMORIES CAN BE STRENGTHENED, ALTERED AND MANIPULATED –

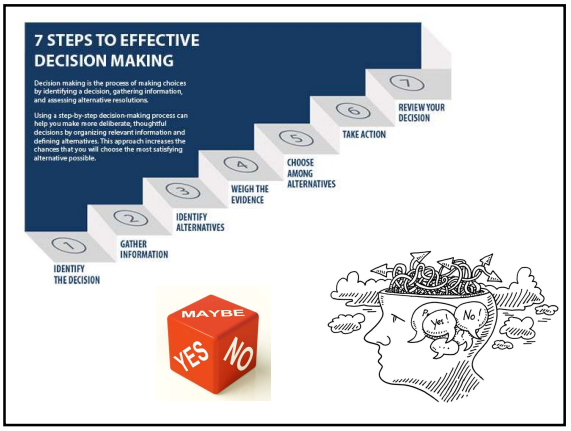


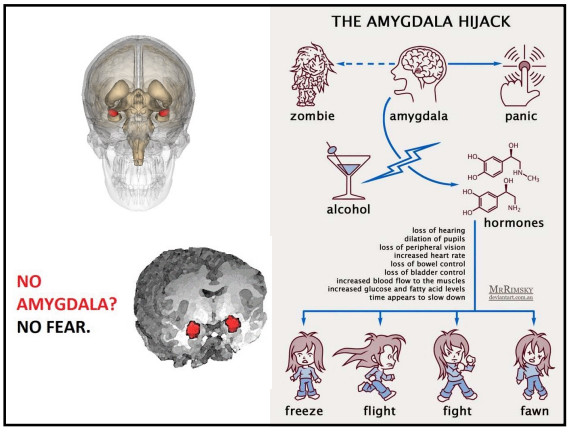
6. Decision-making

"Somatic markers" are feelings in the body that are associated with emotions, such as the association of rapid heartbeat with anxiety or of nausea with disgust. According to the hypothesis, somatic markers strongly influence subsequent decision-making.
Within the brain, somatic markers are thought to be processed in the **ventromedial prefrontal cortex** and the **amygdala**.









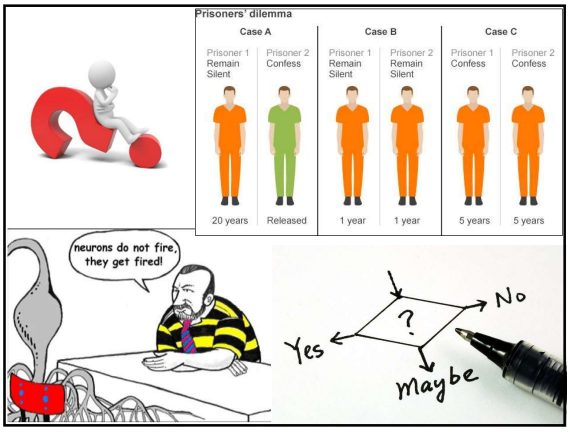
The way the problem is presented influences the decision

- Group 1:
  - **A: 200/600 saved**
  - B: 30% all saved
- Group 2:
  - C: 400 die
  - **D: 30% none dies**

75%

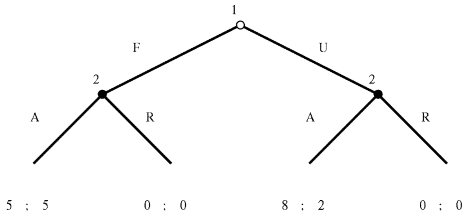
6. Decision-making

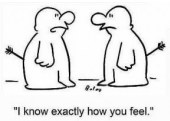
TAKE HOME MESSAGE:
– HOW DO WE CHOOSE THE BEST COURSE OF ACTION? –



7. Reward and motivation

The *ultimatum* game

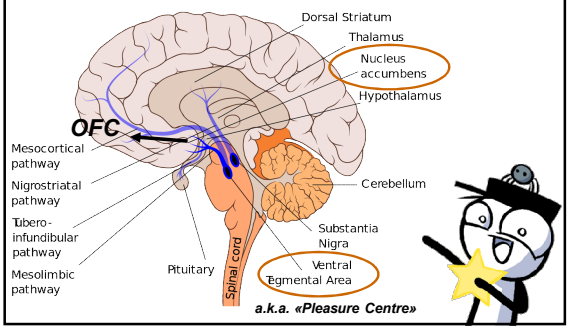


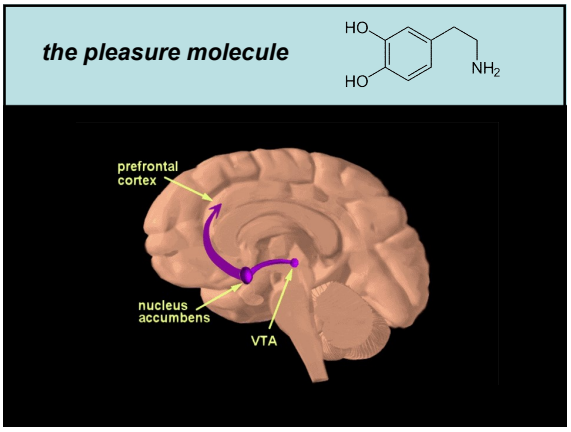


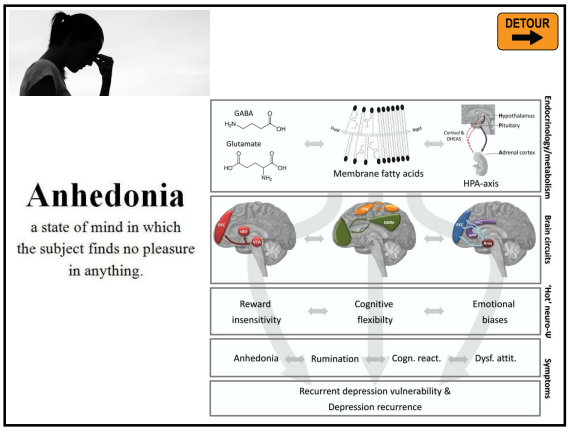
"I know exactly how you feel."

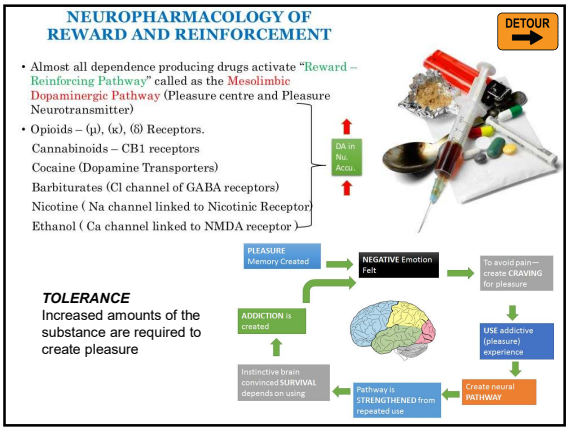
"[Motivation is] ... all those pushes and pulls ... that defeat our laziness and move us, either eagerly or reluctantly, into action
George Miller, 1962

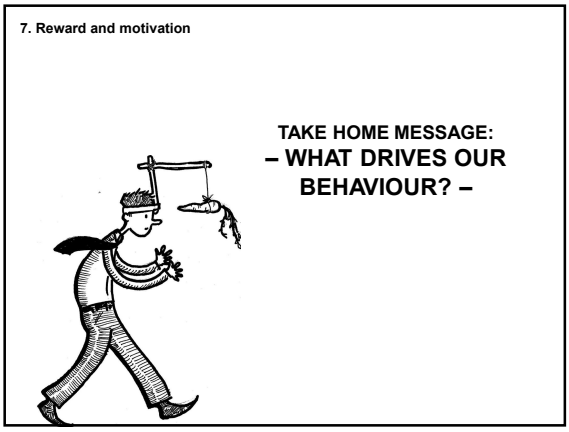
1. **Mesolimbic pathway**
2. **Nigrostriatal pathway**

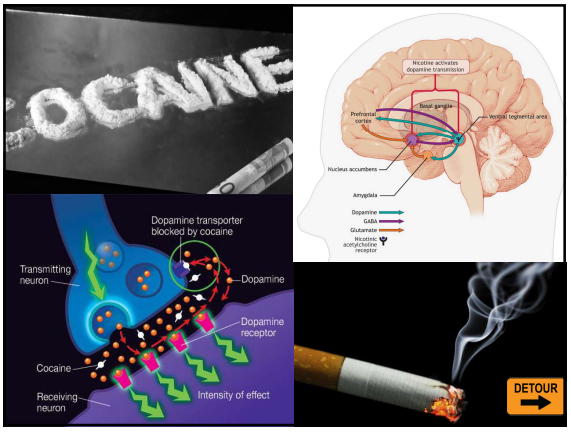


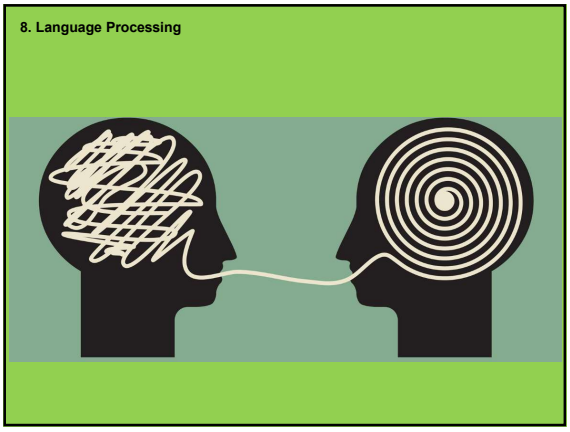

the pleasure molecule
HO
HO
NH2
prefrontal cortex
nucleus accumbens
VTA


DETOUR
Anhedonia
a state of mind in which the subject finds no pleasure in anything.
GABA
Glutamate
Membrane fatty acids
HPA-axis
Endocrinology/metabolism
Brain circuits
'Hot' neuro-ψ
Symptoms
Reward insensitivity
Cognitive flexibilty
Emotional biases
Anhedonia
Rumination
Cogn. react.
Dysf. attit.
Recurrent depression vulnerability & Depression recurrence

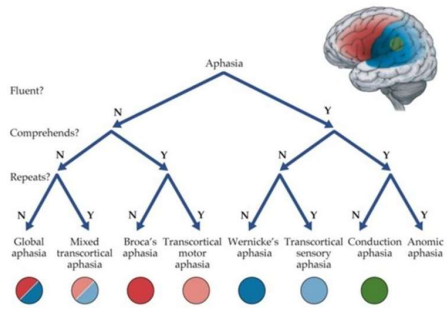

NEUROPHARMACOLOGY OF REWARD AND REINFORCEMENT
DETOUR
• Almost all dependence producing drugs activate "Reward – Reinforcing Pathway" called as the Mesolimbic Dopaminergic Pathway (Pleasure centre and Pleasure Neurotransmitter)
• Opioids – (μ), (κ), (δ) Receptors.
Cannabinoids – CB1 receptors
Cocaine (Dopamine Transporters)
Barbiturates (Cl channel of GABA receptors)
Nicotine (Na channel linked to Nicotinic Receptor)
Ethanol (Ca channel linked to NMDA receptor)
DA in Nu. Accu.
TOLERANCE
Increased amounts of the substance are required to create pleasure
PLEASURE Memory Created
NEGATIVE Emotion Felt
To avoid pain— create CRAVING for pleasure
ADDICTION is created
USE addictive (pleasure) experience
Instinctive brain convinced SURVIVAL depends on using
Pathway is STRENGTHENED from repeated use
Create neural PATHWAY


7. Reward and motivation
TAKE HOME MESSAGE:
– WHAT DRIVES OUR BEHAVIOUR? –


COCAINE
Dopamine transporter blocked by cocaine
Transmitting neuron
Dopamine
Dopamine receptor
Cocaine
Receiving neuron
Intensity of effect
Nicotine activates dopamine transmission
Basal ganglia
Prefrontal cortex
Ventral tegmental area
Nucleus accumbens
Amygdala
Dopamine
GABA
Glutamate
Nicotinic acetylcholine receptor
DETOUR

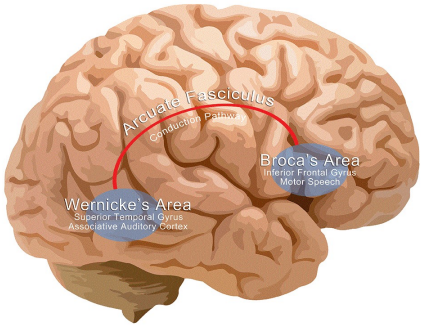

8. Language Processing

'The integrity of the third frontal convolution seems indispensable to the exercise of the faculty of articulate language.'
Pierre Paul Broca, 1861



8. Language Processing

TAKE HOME MESSAGE:
– THE BRAIN CONTAINS MULTIPLE, COMPLEX CIRCUITS DEDICATED TO LANGUAGE –

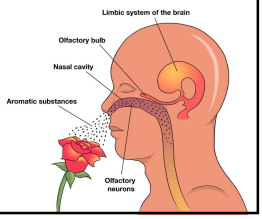


9. Executive function

Executive function refers to the brain's control system, which enables us, among other things, to organize our thoughts and behaviours, prioritize and plan tasks, and make decisions.

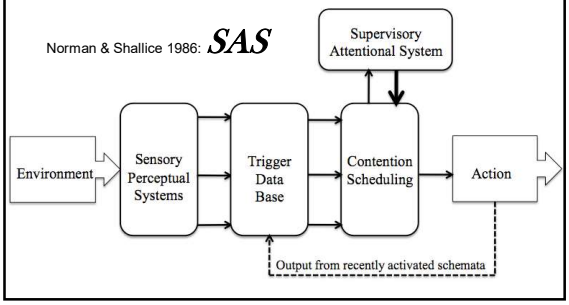
… multi-component system
that supervises and coordinates other high-level mental functions

Executive function emerged with the evolution of the modern mind – it is tied to the prefrontal cortex, a part of the brain far more highly developed in human beings than in our closest primate ancestors.
Costandi, Moheb. 50 Human Brain Ideas You Really Need to Know.



'In normal adults the frontal lobes exert control over behaviour in part as a result of their control over the level of activation aroused by different kinds of stimuli.'
Alexander Luria, 1979

Norman & Shallice 1986: ***SAS***



9. Executive function

TAKE HOME MESSAGE:
– THE BRAIN'S 'CONTROL SYSTEM', WHICH SUPERVISES AND REGULATES OTHER MENTAL PROCESSES –

Stroop 1935

PURPLE YELLOW RED
BLACK RED GREEN
RED YELLOW ORANGE
BLUE PURPLE BLACK
RED GREEN ORANGE

giallo	blu	arancione
nero	rosso	verde
viola	giallo	rosso
arancione	verde	nero
blu	rosso	viola
verde	blu	arancione

the marshmallow test: 3-5 y.o.