

Autonomic nervous system

- Parasympathetic compartment of the autonomic nervous system - localization of preganglionic and postganglionic neurons, neurotransmitters and their receptors at parasympathetic junctions. Responses of effector organs to parasympathetic stimulation.
- Sympathetic compartment of the autonomic nervous system - localization of preganglionic and postganglionic neurons, neurotransmitters and their receptors at sympathetic junctions. Responses of effector organs to sympathetic stimulation.

Learning and memory

- **learning** = neurophysiological processes that leads to change in behaviour on the basis of knowledge about the world (experience)
- **memory** = processes that enable to store, retain and retrieve learned information
- amnesia: retrograde and anterograde

Patient HM

- only memory impairment
- only declarative memory
- working memory OK
- nondeclarative memory OK

Memory – two dimensions

- the time course of storage
- the nature of the information stored

The time course of storage

- sensory
- short-term (working)
- long-term

Short-term = working memory

- more subsystems (Baddeley`s model), that are coordinated by the executive control processes – allocation of attention
- repeated store and rehearsal

working memory

central executive

phonological
loop

episodic
buffer

visuospatial
sketchpad

language

episodic
memory

visual
semantics

long-term memory

Short-term = working memory

- dorso- and ventrolateral prefrontal and posterior parietal cortices, inferior temporal cortex,
- modulation by dopamine

Long-term memory

- explicit = declarative
- implicit = nondeclarative

Declarative (explicit)

- factual knowledge of people, places, things and situations → semantic and episodic
- repetition is not necessary

Declarative (explicit)

- accessible by different systems (visual, auditory....)
- information can be abstract
- dependent on the medial temporal lobe structures:
hippocampal formation - hippocampus, entorhinal cortex,
mammillary bodies, thalamus
- memory is recalled consciously - working memory is needed

Declarative (explicit)

- is stored in association cortices
- involves at least four distinct processes
 - encoding
 - storage, consolidation
 - retrieval

Encoding

- refers to the processes by which newly learned information is attended to and processed when first encountered
- influenced by motivational systems

Storage

- the mechanism and sites by which memory is retained over time
- it seems to have unlimited capacity (?)

Consolidation

- processes that alter the newly stored and still labile information so as to make it more stable for long-term storage
- involves expression of genes and the synthesis of new proteins
- after the encoding the memory is vulnerable to electric shock or proteosynthesis inhibitors
- retrograde amnesia

Retrieval

- processes that permit to recall and use of the stored information
- it is constructive process → subject to distortion (is much like perception)
- is no longer dependent on the hippocampus but partially dependent on working memory

Episodic memory (events)

- a complex interaction between medial temporal lobe and prefrontal cortex and other association areas

Semantic memory (facts)

- is not associated with the context in which the information was acquired
- association cortices – inferior temporal (and fusiform gyrus)
- retrieval – prefrontal cortex

Nondeclarative (implicit, reflexive, procedural)

- reflexive motor or perceptual skills
- repetition is necessary
- accessible for one system

Nondeclarative (implicit, reflexive, procedural)

- specific information storage
- independent on hippocampus
- memory is recalled unconsciously

Nondeclarative (implicit, reflexive, procedural)

- sensorimotor skills, perceptual learning (mirror reading)
 - BG, cerebellum and neocortex
- priming - neocortex

Nondeclarative (implicit, reflexive, procedural)

- **nonassociative** (learning about properties of one stimulus)
 - **habituation** – a decrease in a response when a benign stimulus is presented repeatedly
 - **sensitization** – enhanced response to a wide variety of stimuli after the presentation of an intense or noxious stimulus.

Nondeclarative (implicit, reflexive, procedural)

- **associative**
 - classical conditioning (learning a relationship between two stimuli)
 - operant conditioning (learning a relationship between stimulus and behavior, or between the organism's behavior and the consequence of that behavior)

Classical conditioning

- pairing of two stimuli
- unconditioned stimulus (US) -
 - appetitive (food), defensive (a shock)
 - it produce overt response (unconditioned), such as salivation or withdrawal of the leg
- conditioned stimulus (CS)
 - a light, tone
 - it produce no overt response

Classical conditioning

- extinction – the probability of occurrence of a conditioned response decrease if the CS is repeatedly presented without US
- an important adaptive mechanisms
- it is not forgetting but that something new is learned – the CS now signals that US will not occur

Car driving

- some learned behaviours involve both implicit and explicit forms of memory

Neurophysiology mechanisms of memory

- neuronal plasticity – changes of synaptic transmission effectiveness, new connections between neurons

Speech and language

- allows people to communicate an unlimited combination of ideas using a highly structured stream of sounds (or, in signed languages, of manual and facial gestures).

Speech and language

- **phones** - vowel and consonant
(total 200; 30-40/language)
- **phonemes**
- syllables
- words
- sentence

Language

- is learned and the capacity to learn is innate

<i>Aphasia</i>	<i>Spon- taneous Speech</i>	<i>Repeti- tion</i>	<i>Articula- tion</i>	<i>Compre- hension</i>	<i>Sentence Structure, Choice of Words</i>	<i>Naming</i>	<i>Commonly Associated Neurologi- cal Deficits</i>
Broca aphasia	Markedly dimi- nished	Severely impaired	Dysar- thric	Normal	Agram- matism, phonemic paraphasic errors	Mildly impaired	Right hemi- paresis and left apraxia

Broca`s aphasia

- Broca`s area (a45, a44), also a6, 8, 9, 10, 46; white matter, insula, BG

<i>Aphasia</i>	<i>Spontaneous Speech</i>	<i>Repetition</i>	<i>Articulation</i>	<i>Comprehension</i>	<i>Sentence Structure, Choice of Words</i>	<i>Naming</i>	<i>Commonly Associated Neurological Deficits</i>
Wernicke aphasia	Normal	Severely impaired	Normal	Severely impaired	Paragrammatism, semantic paraphasic errors, neologisms	Severely impaired	Right homonymous hemianopsia

Wernicke`s aphasia

- lesions in a22, gyrus temporalis medius a white matter

Other brain areas important for language

- left insula – is important for planning or coordinating the articulatory movements necessary for speech
- the supplementary motor area and the anterior cingulate region (Brodmann's area 24), play an important role in the initiation and maintenance of speech
- inferotemporal cortices - categories of things but not words denoting the actions of the things or their relationships to other entities
- fasciculus arcuatus – bidirectional system

Modern concept

systems: language implementation (analyses incoming sensory signals so as to activate conceptual knowledge and also supports phonemic and grammatical construction and control speech production), mediational, conceptual (a collection of regions distributed throughout association areas providing conceptual knowledge)

Speech non-dominant hemisphere

- **prosody** - intonation and melody
 - frontal area (corresponds to Broca`s area)
 - temporal area (corresponds to Wernicke`s area)
- prosodic information:
 - linguistic, conveying semantic meaning (Mandarin Chinese, Thai)
 - paralinguistic, expressing our attitudes and emotions

Functional specificity of hemispheres

- Wada test (sodium amytal)
- tachistoscopic test
- dichotic auditory test

- split brain patients

TABLE 19.3 Functions of the Dominant and Nondominant Hemispheres

**DOMINANT (USUALLY LEFT)
HEMISPHERE FUNCTIONS**

Language

Skilled motor formulation (praxis)

Arithmetic: sequential and analytical calculating skills

Musical ability: sequential and analytical skills in trained musicians

Sense of direction: following a set of written directions in sequence

**NONDOMINANT (USUALLY RIGHT)
HEMISPHERE FUNCTIONS**

Prosody (emotion conveyed by tone of voice)

Visual-spatial analysis and spatial attention

Arithmetic: ability to estimate quantity and to correctly line up columns of numbers on the page

Musical ability: in untrained musicians, and for complex musical pieces in trained musicians

Sense of direction: finding one's way by overall sense of spatial orientation

Left hemisphere functions

Analysis of right visual field

Stereognosis (right hand)

Lexical and syntactic language

Writing

Speech

Right hemisphere functions

Analysis of left visual field

Stereognosis (left hand)

Emotional coloring of language

Spatial abilities

Rudimentary speech