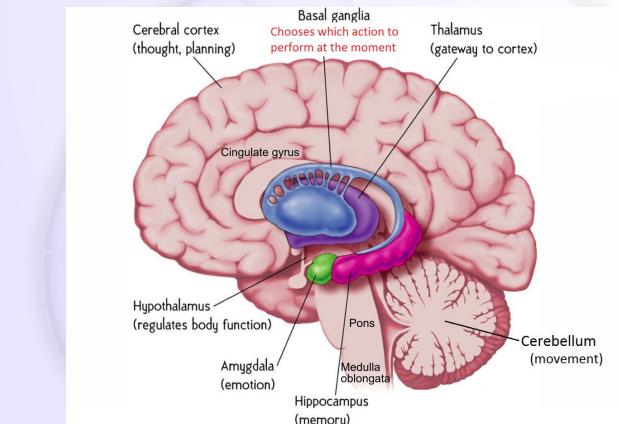


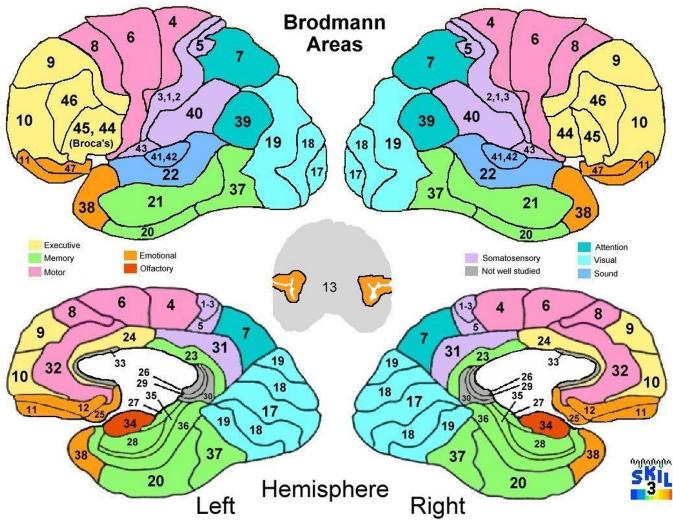
Brain Areas

Computational Cognitive Neuroscience
Randall O'Reilly

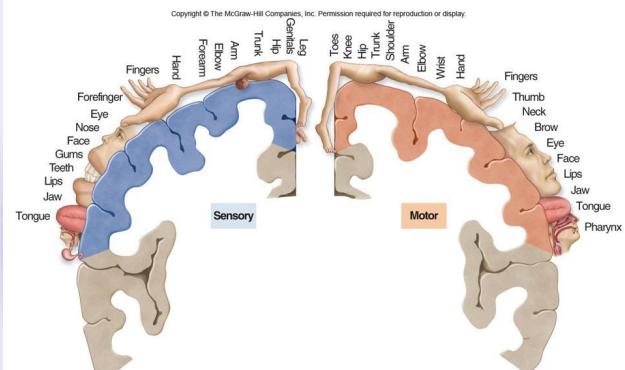
Gross Anatomy



2

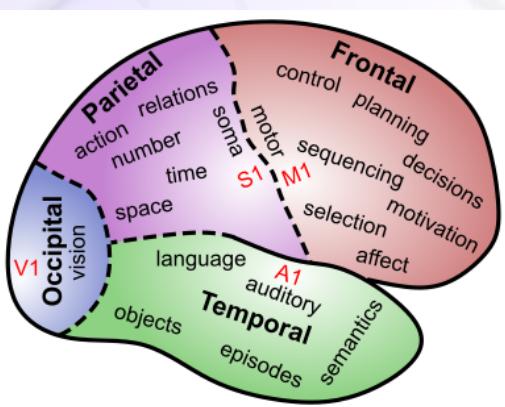


Sensory/Motor Homunculus



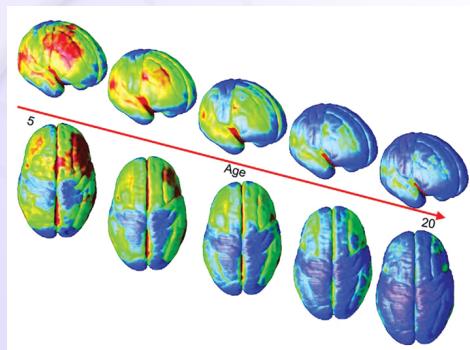
4

Lobular Functions



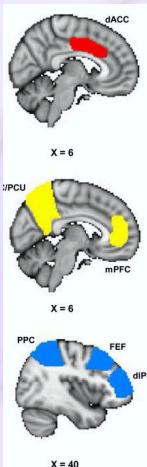
5

Brain Maturation: Synaptic Pruning



Blue = thinner = more synapses pruned = more mature
Sensory areas mature first, then "higher level" areas; PFC last of all

Functional Networks



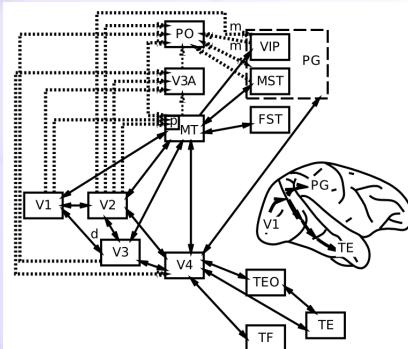
Salience: "hot" network of medial, ACC, Amygdala, Insula

"Default" network (where your brain likes to go): ruminating, mind-wandering, planning, autobiographical memories (+ hippocampus)

"Control" network: Parietal <-> Frontal network for directing attention, eye movements, manual behavior on cognitive tasks

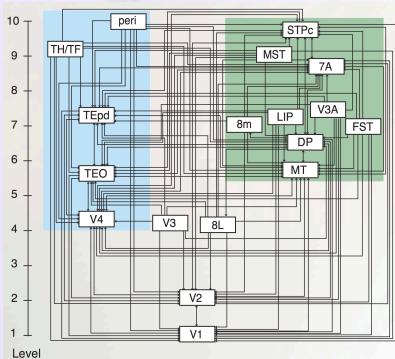
7

Visual Hierarchy: What vs Where



8

"Van Essen" Hierarchy

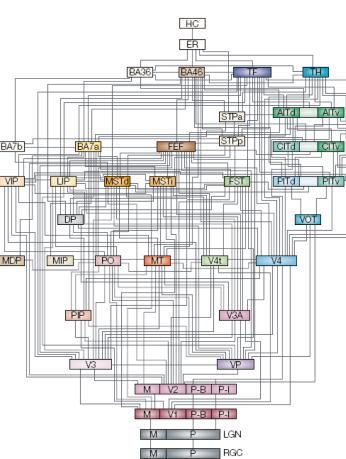


TE.. = Temporal
LIP, DP.. = Parietal
8L = Frontal Eye Field

To hippocampus:
TH/F = Parahippo
peri = Perirhinal

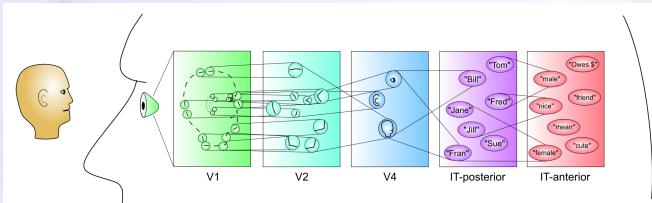
Markov et al., 2014

9



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Hierarchy of Detectors..



11

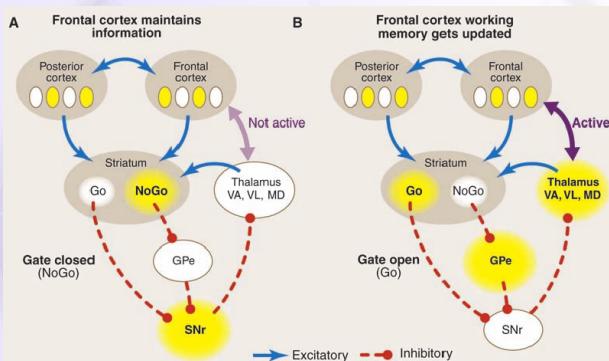
Learning Rules Across the Brain

Area	Learning Signal			Dynamics		
	Reward	Error	Self Org	Separator	Integrator	Attractor
Primitive Basal Ganglia	+++	---	---	++	-	---
Cerebellum	---	+++	---	+++	---	---
Advanced Hippocampus	+	+	+++	+++	---	+++
Neocortex	++	+++	++	---	+++	+++

+= has to some extent ... +++= defining characteristic – definitely has
-= not likely to have ... ---= definitely does not have

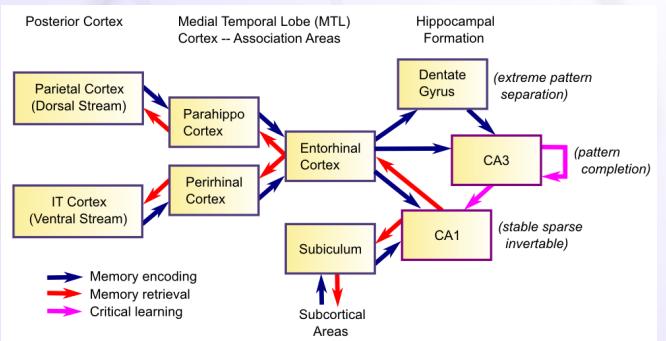
12

Motor Control: BG, Cerebellum



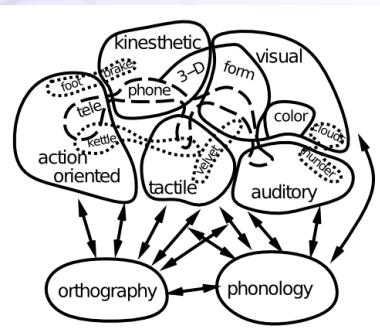
13

Memory and the Hippocampus



14

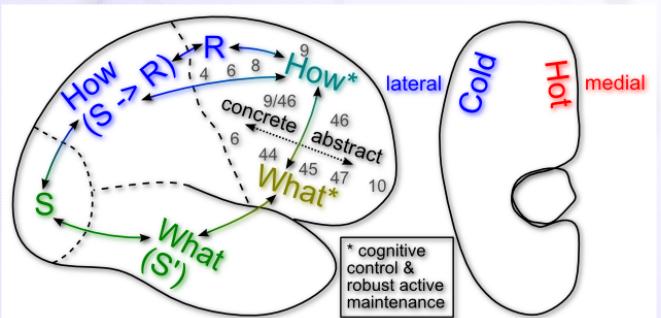
Language



- Lots of areas working together..

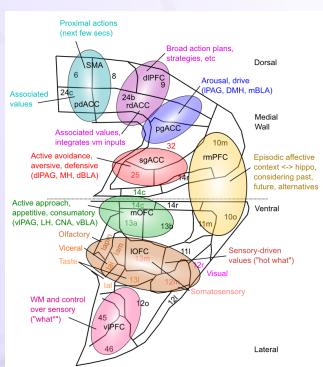
15

Executive Function



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Medial Frontal Map of Values



17

Neurotransmitter Terms

- Agonist:** acts like a given neurotransmitter
- Antagonist:** blocks receptors for given NT
- Reuptake:** takes NT back out of synapse
- Neuromodulator:** a broadly-released neurotransmitter that has widespread modulatory effects on the brain

Neuromodulators and Drugs *(receptor agonists)*

- **Acetylcholine (ACh):** muscles, attention, learning, memory (nicotine)
- **Dopamine (DA):** when to learn, based on reward prediction errors (cocaine)
- **Norepinephrine (NE):** attention, engagement (speed)
- **Serotonin (5HT):** Mood, sleep, appetite, sex, stress (SSRI, LSD = waking dream)
- **Oxytocin:** social modulation, labor (pitocin)
- **Endorphins, Substance P:** pain (heroin)