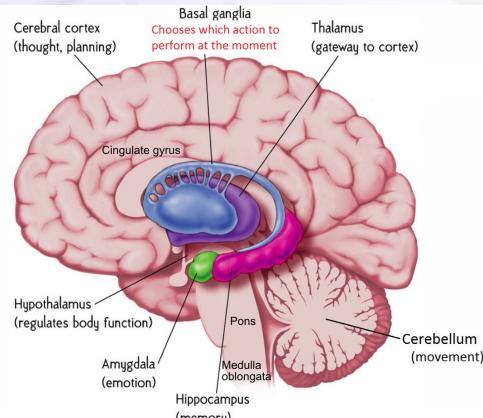


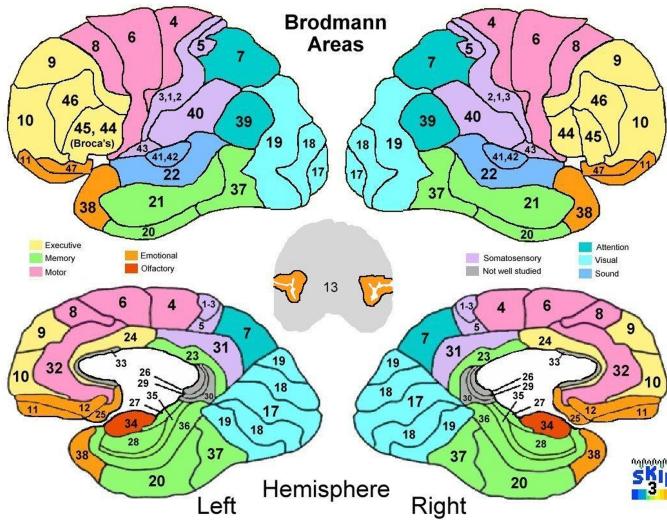
Brain Areas

Computational Cognitive Neuroscience
Randall O'Reilly

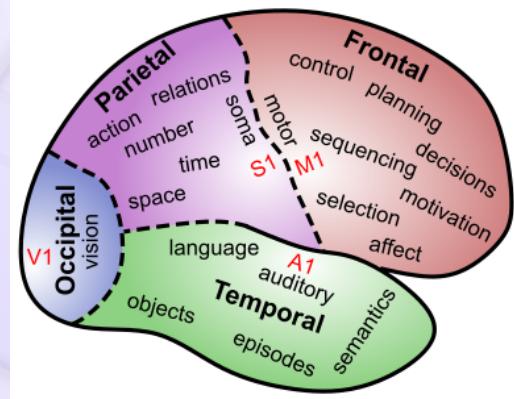
Gross Anatomy



2

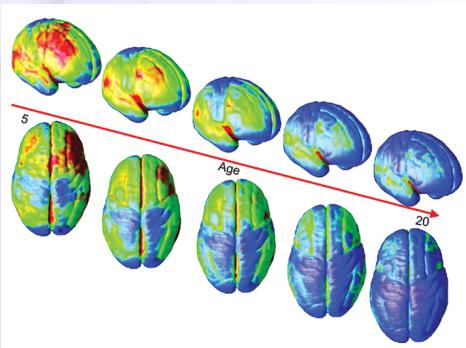


Lobular Functions



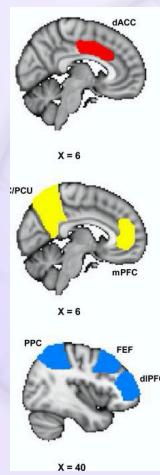
4

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



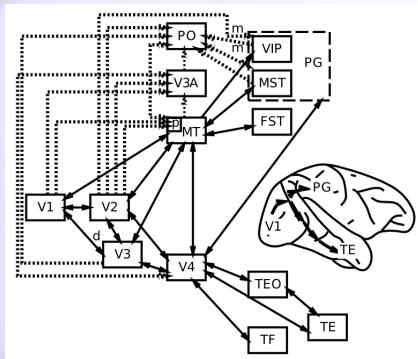
Salience: "hot" network of medial, ACC, Amygdala, Insula

"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

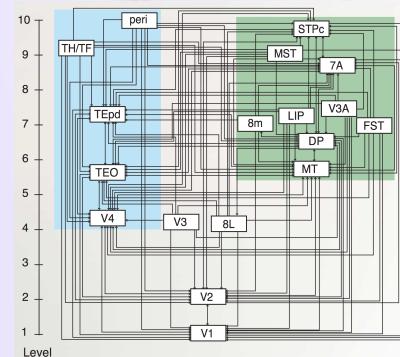
6

Visual Hierarchy: What vs Where



7

“Van Essen” Hierarchy



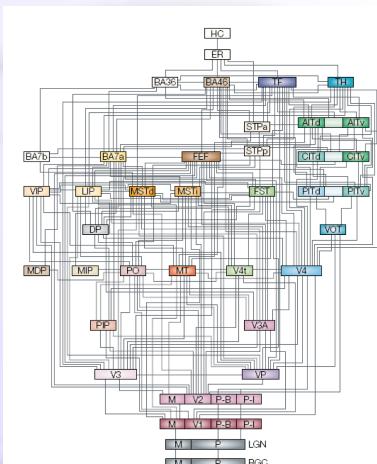
Markov et al., 2014

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

To hippocampus:
TH/F = Parahippo
peri = Perirhinal

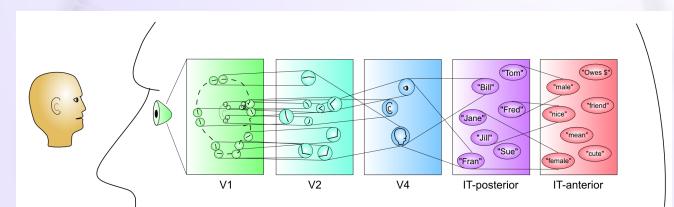
To hippocampus:
TH/F = Parahippo
peri = Perirhinal

8



9

Hierarchy of Detectors..



10

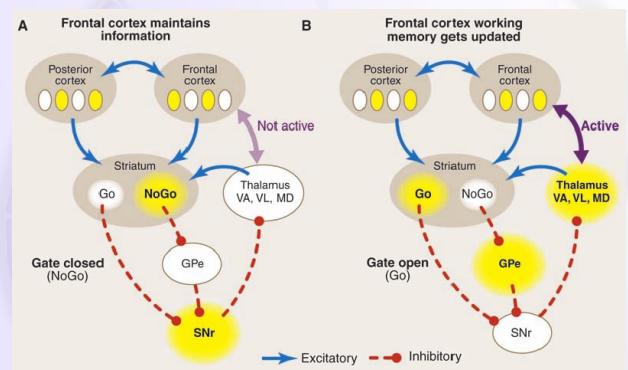
Learning Rules Across the Brain

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

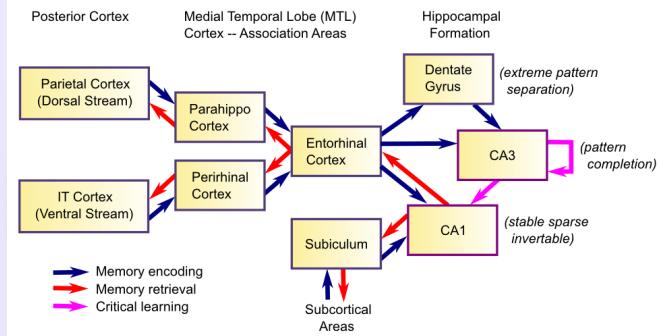
1

Motor Control: BG, Cerebellum



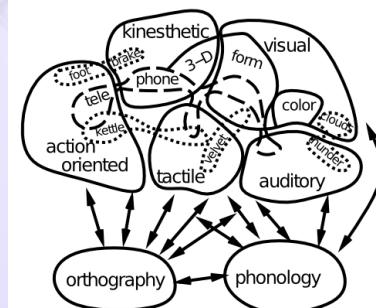
12

Memory and the Hippocampus



13

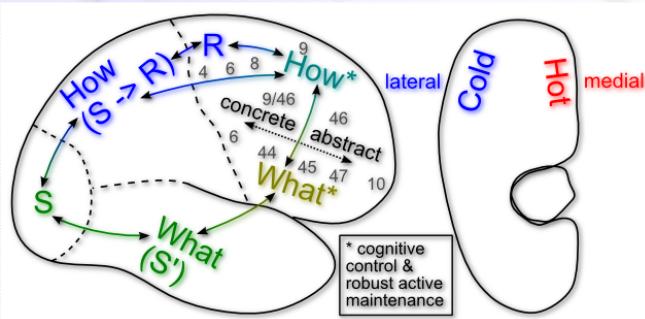
Language



- Lots of areas working together..

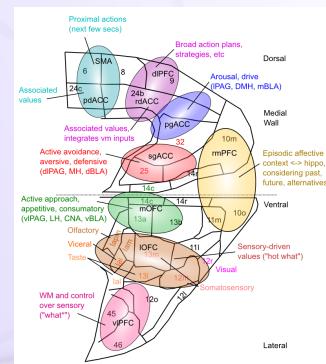
14

Executive Function



15

Medial Frontal Map of Values



16

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)