

Consciousness, Drugs, Sleep & Dreams

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What is Consciousness?

Searle: "Consciousness consists of inner, qualitative, subjective states and feelings or awareness"

- **Qualitativeness:** "feels like something.."
- **Subjectivity:** each person has their own, cannot be experienced outside of a being..
- **Unity:** single unified experience at each moment: not disjointed grab-bag of uncoordinated stuff..

The “hard problem”

Chalmers: How does a physical system (the brain) produce this amazing thing we experience as consciousness?

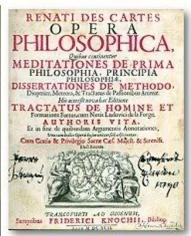
- In other words, can we come up with an **objective** understanding of **subjective** experience? **qualia** = "what it feels like"
- vs. "easy" problems: ability of system to access its own internal states, report on them; ability to focus attention; deliberate control of behavior...

Descartes: Cogito Ergo Sum

I think, therefore I am

Subjective cognition is **primary**

Solipsism: subjective cognition **is all there is!**



Dualism: mind is separate from brain

Dueling Dualisms

Substance dualism: mind / soul vs. matter

- but how do they interact ever?

Perspective dualism: subjective vs. objective

- subjective is primary

- I believe in objective reality: my subjective experience makes sense in my understanding of objective reality (brain -> subjective experience)

- But no way to provide objective explanation in terms of neurons etc of "what it feels like":

You have to be a brain to know what it feels like!

Consciousness = Human

Consciousness is just another name for what it's subjectively like to "live" inside a human brain

- Because we are human, consciousness = human
- *Nothing else has human consciousness, by definition.*
- BUT, animals share many brain features, and their subjective experience is likely to be similar in various ways.. But never the same.
- No animal poets (yet) – literature = qualia..
- And btw, I don't even know about you..

Consciousness Science

Forget about all the philosophical mumbo-jumbo, and just do objective science on consciousness phenomenology:

- When are people conscious, not, or altered?
- What features / states of brain associated with different states of consciousness?
- What features of subjective consciousness associate with different features of brain?

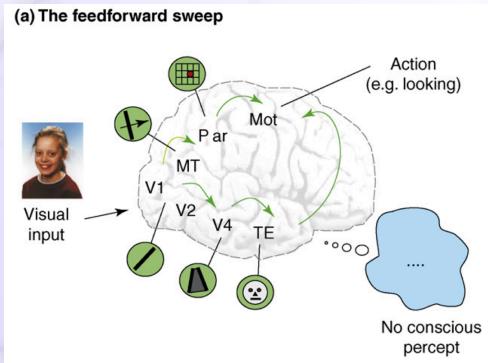
NCC: Neural Correlates of Consciousness

What Counts as Conscious?

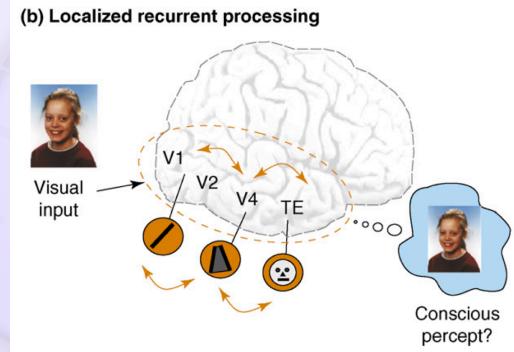
?	Evidence of conscious experience
?	Evidence of unconscious processing
?	
	Verbal report
	Detection in Yes/No task
	Evidence of storage in episodic memory
	...
	Planning behavior
	Storage in working memory
	...
	Cognitive manipulation (e.g.calculus)
	Mental rotation
	Response inhibition and countermanding
	...
	Object recognition
	Localization
	Eye movements
	Forced choice guessing
	...
	Evidence of semantic processing
	Judging emotional expression
	Evidence of priming
	...
	Skill acquisition
	Perceptual learning
	Adaptation
	...
	Galvanic skin response
	Pupil dilation

TRENDS in Cognitive Sciences

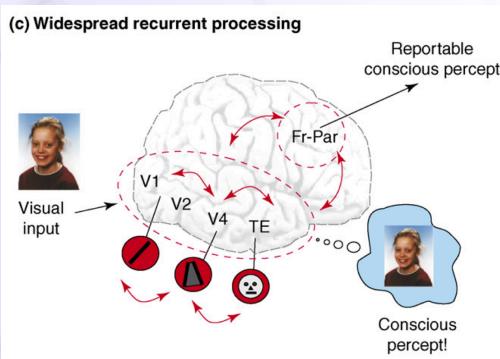
Recurrent Processing = Consciousness (Lamme, 2006)



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Recurrence == Consciousness

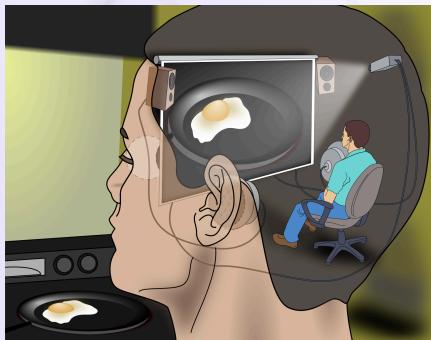
Consciousness is *Unitary*

Recurrence coordinates all areas on one thing
(That thing emerges through popular vote)

Consciousness is *Functional*

We learn more about conscious things
It helps us organize, prioritize our behavior
“Focusing” is necessary for difficult problems

Is the Pulvinar the Silver Screen of the Cartesian Theater??



We have a compelling feeling that our conscious selves are watching a movie – pulvinar is kind of a movie screen where all of our predictions are projected, at V1 resolution.. hmm..

Global workspace?
Brain synchronizer?

Is Twitter Conscious?

Tononi attempted to provide a mathematical measure of consciousness: integrated information
-- many physical systems could have high values, e.g., a bunch of logic gates.

Twitter is a big recurrent network of communicating entities, like a neural network – is it conscious?

Metacognition



Awareness of awareness is also a key ingredient of human consciousness – likely associated with prefrontal cortex and other high-level brain areas.

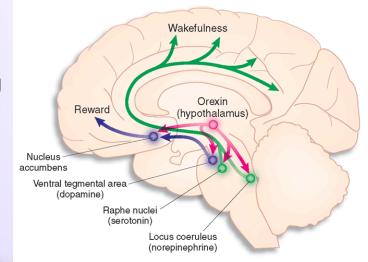
Are you conscious when you're not "mindful"?

Altering Consciousness via Drugs

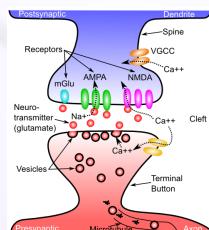
Drugs plug into native neurotransmitter pathways in the brain – provide a unique window into understanding how the brain works.

Reticular activating system:

VTA, SNC: Dopamine: learning
Raphe: Serotonin: sleep mood
LC: Norepinephrine: effort
Basal forebrain: Ach: attention



Neurotransmitters



- **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)
- **GABA:** inhibition (benzo, valium, etc)

Drug Categories

Narcotics: Opium derivatives (heroin, morphine..): opioid receptor agonists

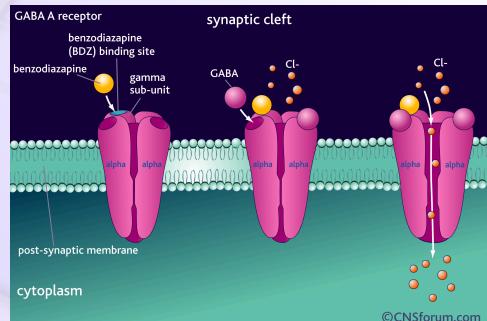
Depressants: Benzo, Valium: GABA inhibition agonists

Stimulants: nicotine (ACh receptor agonist), cocaine (Dopamine receptor agonist), amphetamine (Norepinephrine + receptor agonist), caffeine (Adenosine antagonist -> Dopamine agonist)

Psychedelics: LSD, peyote, mescaline, psilocybin: affect serotonin; Marijuana: cannabinoid receptors

Benzo, Valium, etc

Agonist for GABA inhibitory channels



Mouse Party!

- <http://learn.genetics.utah.edu/content/addiction/mouse/>

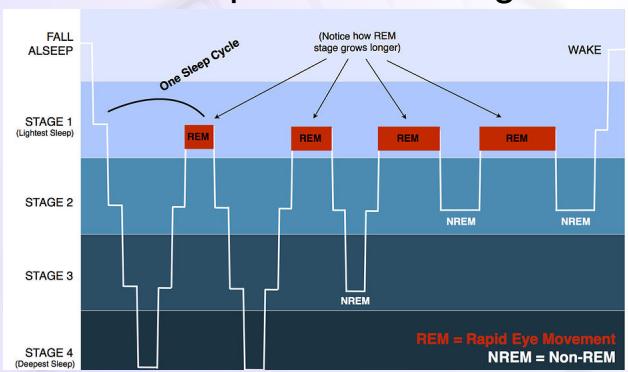
Addiction -> Dependence Terms

Withdrawal: unpleasant feelings from lack of use

Craving: overpowering feeling of wanting

Tolerance: progressive need for more to get same effect

Sleep and Dreaming



Deeper = slower frequency brain waves (Theta -> Delta)

REM & Awake = Beta, Alpha, Theta

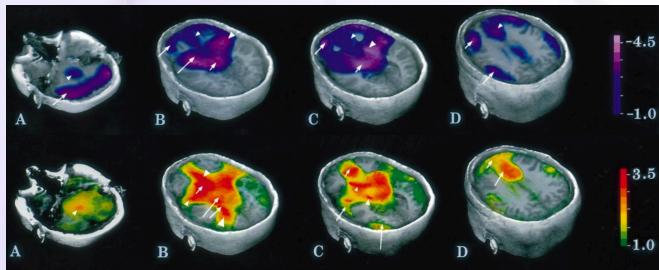
Why do we sleep?

Rebuild infrastructure: anabolic, protein synthesis

- Catabolic = breaking down (during day)
- Use brain during day, (re)build at night
- Why babies sleep so much..

- = better memory in am: “consolidated” synapses
- Sleep is key for health, immune function

Your PFC Goes to Sleep



And your limbic system wakes up!

- Dreams are disorganized, inconsistent over time
- And very emotionally charged: lots of fear and lust..

Braun et al, 1997: <http://brain.oxfordjournals.org/content/brain/120/7/1173.full.pdf>

Why do we dream?

Epiphenomenon of random activity?

Replaying events of the day, to consolidate?

- Slow-Wave-Sleep: 50% dreaming
- REM: 80% dreaming – more vivid, memorable

Still don't know if content of dreams matters..

Hypnosis

Unclear if a distinct state of consciousness, or just a combination of relaxed state, social suggestibility and role playing.

Bottom line: people are *lemmings*!