Computational Social Cognitive Neuroscience

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What is Social Cognitive Neuroscience?

- Encompasses any cognitive process that deals with conspecifics, either in a group scenario or one-on-one
- Are the key cognitive processes that govern language, perception, memory/attention also responsible for social interaction and formation?
- What governs the social aspect of our lives?

Social Learning

- Learning is more than a person stumbling through actions themselves until they get better or passively taking in information to build self-organized structures
- Mimicry or mirroring is a heavily studied area of social cognitive neuroscience

Mirror Neurons

- Neurons primarily in the premotor cortex that activate when observing actions of other conspecifics
- Activate in the subject as if it was the subject itself doing the action
- Research indicates these neurons distinguish from biological vs non-biological actions

Learning From Others

- Vicarious Reinforcement Learning is a learning strategy where the subject observes the actions and outcomes of someone else.
- Predictions seem to take place in the dlPFC while outcomes predicted in vmPFC

$$V = V_{t-1} + \alpha\,\delta_t$$

Judging Others Intentions

- Action Imitation as a learning mechanism can work similarly to vicarious reinforcement learning
- Work or Shirk: can shirk for gain but need to think about the intentions of others.
- Self choice held in vmPFC while non-executed choices held in dmPFC

$$I_{t+1} = I_t * E_t$$

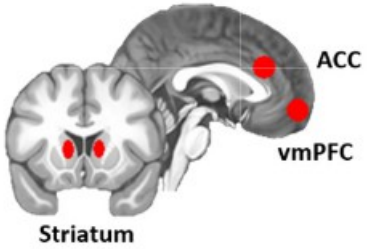
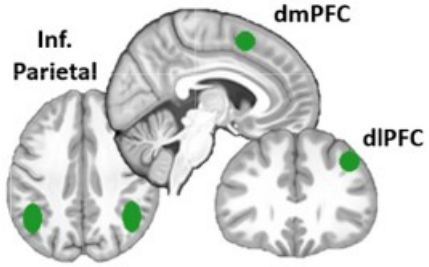
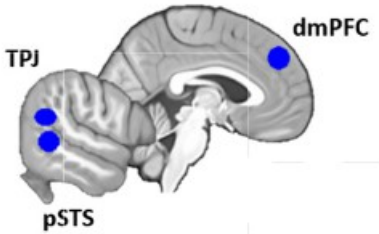
Learning About Others

- Learning about others is different than passively observing actions
- One game players paired with an advising confederate picked cards with hidden value

$$L_{t+1} = L_t + \beta \, \Delta_t$$

- Subjective influence counts too. Over several studies, things that violated 'social norms' saw increased activity in the ACCg

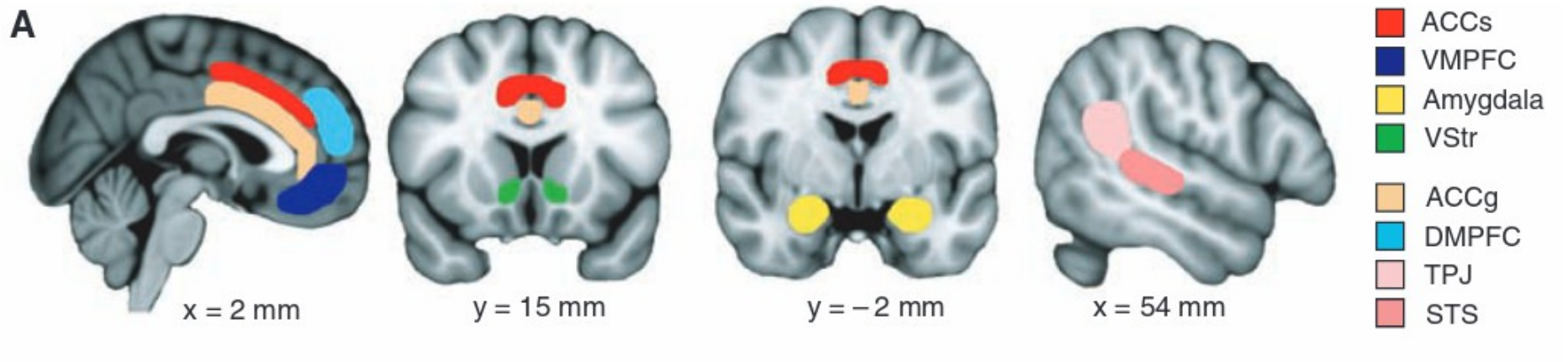
Building A Computational Model

Strategy	Vicarious reward learning	Action imitation	Bayesian inference
Generic learning rule	$Value_{t+1} = Value_t + \alpha_V * oRPE$	$Action_{t+1} = Action_t + \alpha_V * APE$	$Intention_{t+1} = Intention_t * Evidence_t$ *(Posterior = Prior * Likelihood)*
Possible computation	oRPE = other person's actual reward – expected reward	APE = other person's action – predicted action	Bayesian update = $Intention_{t+1} - Intention_t$
Main neural correlate			
Example behaviors	• *Reward & punishment learning* • *Learning preferences, choices and attitude of others*	• *Motor learning* • *Learning sequences of actions* • *Reward & preference learning when outcome unavailable or inference strategy too demanding*	• *Learning other people's goals and intentions* • *Strategic and competitive interactions* • *Integrating multiple social signals (status, confidence, expertise, attitudes, group size, decisions, etc)*
Pros & Cons	↗ Computationally easy Maps onto RL framework ↘ Slow learning Inflexible		↗ Flexible (high accuracy) Fast learning ↘ Computationally demanding Risk of overfitting

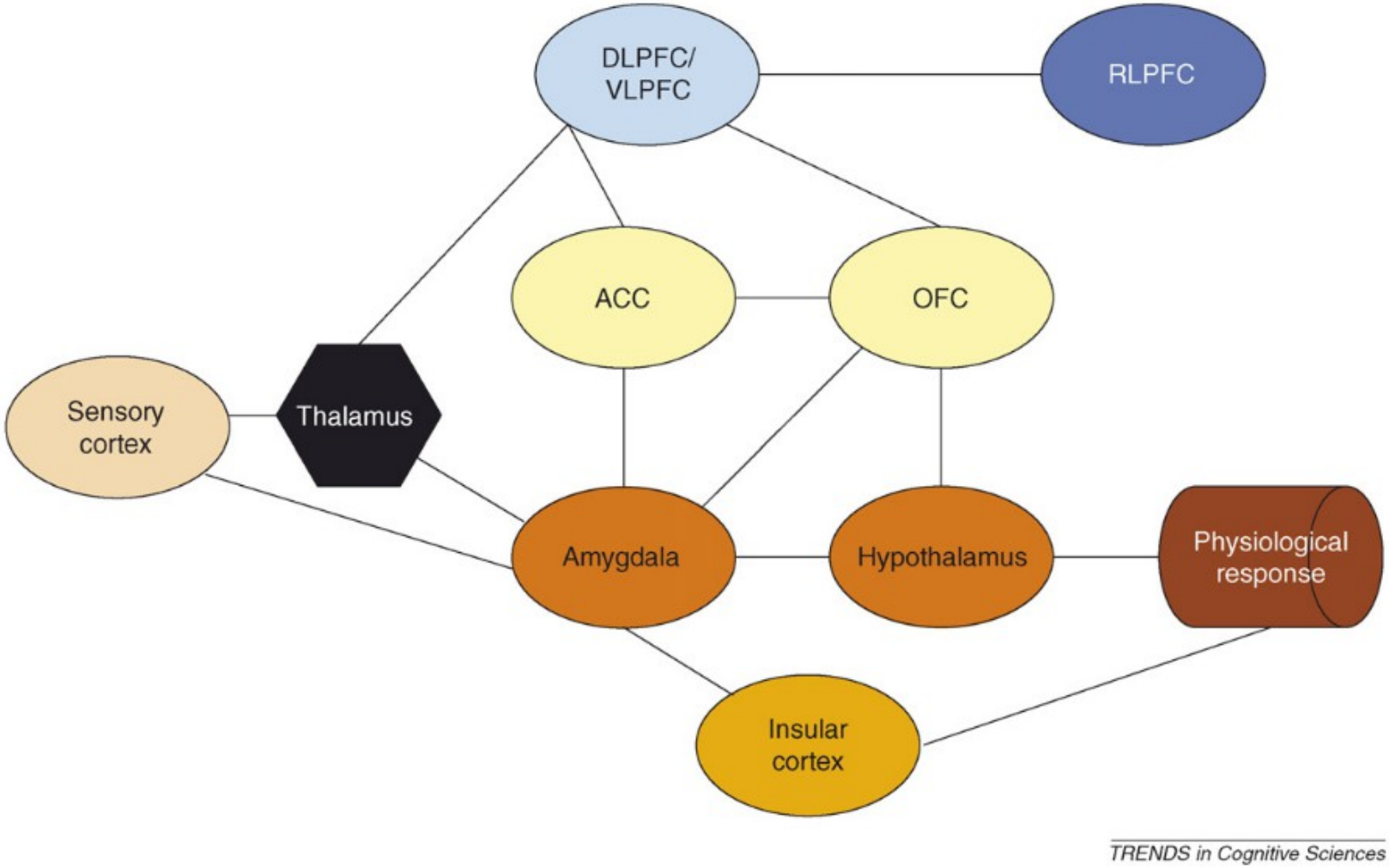
Reflexive and Reflective Systems

- Systems which govern how we think, react, judge, and otherwise function at a very high level
- Reflexive: fast operating, slow learning, bidirectional, parallel processing
- Reflective: slow operating, fast learning, symbolic

Circuitry of Multiple Neural Regions



Neural Model of Evaluation



Conclusion

- This “circuit” in the brain is a very, very rough model but has a lot of influence
- A lot more work needs to be done before we reach a computational model on the level of Emergent/Leabra
- Not even close to answering higher-order self-organization principles

References

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