An Integrative Theory of Prefrontal Cortex Function
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- PFC is thought to be of importance in when behavior must be guided by internal states or intentions or when top-down processing is needed (i.e. Stroop task and Wisconsin Card Sorting task)
  - The theory- PFC actively maintains information needed to carry out goals and the means to achieve them
    - With the diverse and widespread connections the PFC has to the rest of the brain, PFC feedback can influence sensory, motor, and intermediate systems
- PFC must maintain information in face of distractions, but it must also be highly flexible or plastic
- PFC must have connections (going both ways) to a diverse amount of information in the brain, and there is a lot of evidence that it meets this requirement
- There is also evidence that PFC neurons are no only encoding associations between cues and responses or cues and rewards, but also more complex mapping for more complex tasks. (If/then rules)
- PFC sends projections to much of the neocortex and there is evidence that while cortical areas maintain information about the current situation, the PFC maintains information related to the goal, meaning PFC can support active maintenance
  - The PFC’s capacity for active maintenance along with it’s connections to the dopaminergic system may be able to account for associative learning over time
    - There is evidence that midbrain DA neurons seem to be coding the degree to which a reward or cue is surprising
- Simple model of PFC (Figure 4)- units themselves are not responsible for carrying out the input and output mappings but they influence the activity of other units that create the mappings
  - PFC guides flow of activity or it is modulatory and provides influence in other areas of brain
  - Increase in control or cognitive demand will require greater or more enduring PFC activation- evidence supports this role for PFC
  - PFC uses “activity based” control or ongoing activity specifies the pattern of neural pathways needed
  - Activity-based mechanism is highly flexible allowing for flexible updating of representations, however while it must be sensitive to relevant changes, PFC must also be resistant to irrelevant changes
    - DA system is proposed to be important for appropriate updating
- Remaining Issues
  - Mechanism of plasticity that accounts for wide range of behavior
  - How is PFC functionally organized?
  - How do we allocate control?
  - What are the mechanisms of active maintenance?
  - There is limited capacity of control, but what are the limits and what sets them?
  - How do we plan? Where are the representations stored and how are they accessed?