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Higher Level Cognition

What sets us apart?...

1. Your thoughts.
2. Biology and behavior.
3. Computational framework.
4. The Stroop model.
5. Unified account.

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Higher Level Cognition: Your thoughts

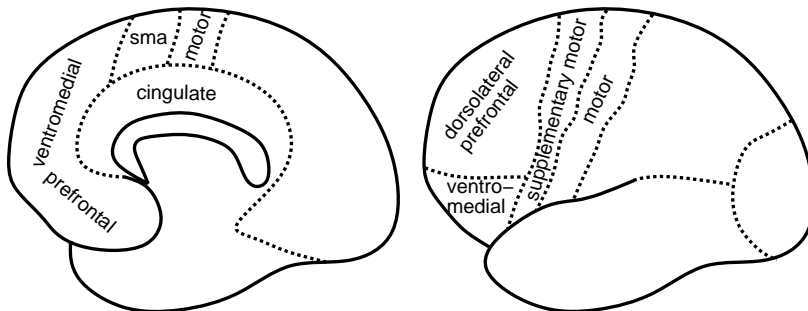
- Plan.
- Social Understanding – give and take, interpreting social events (fluid).
- Decision-making (lacking emotion?).
- Complex logic, propositional reasoning.
- Consciousness, sense of self.
- Free will.

3

Biological Substrates of Higher Level Cognition

Requires entire brain working together..

But frontal cortex, esp. prefrontal (PFC), is really important:



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Range of Frontal Functions

Activation-based working memory Monkey electrophysiology.

Inhibition Stroop: Difficulty inhibiting prepotent response.

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Stroop Task

Yellow Green Red Blue

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Range of Frontal Functions

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Flexibility Continue with same response after task changes, *perseveration*.

Fluency Difficulty generating variety of responses.

Executive control Probs w/ goal-directed planning, coordinating.

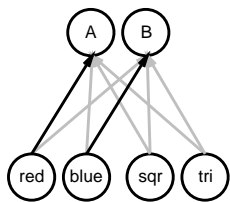
Monitoring/evaluation e.g., Error-monitoring.

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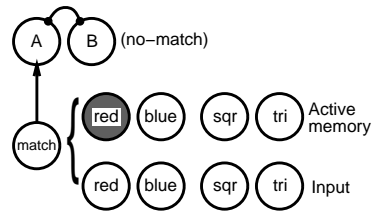
Computational Framework

Key Idea: Activation-based processing (vs weight-based):

a) Weight-based



b) Activation-based



Advantages:

- Flexibility.
- Accessibility.
- Impact.

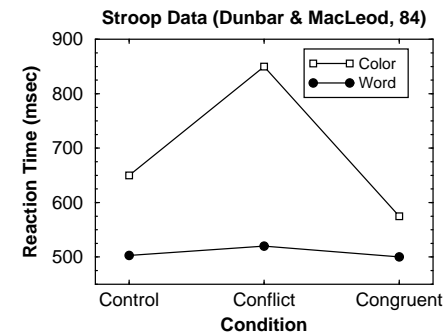
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Stroop Task: Data

Control: Red

Conflict: Red

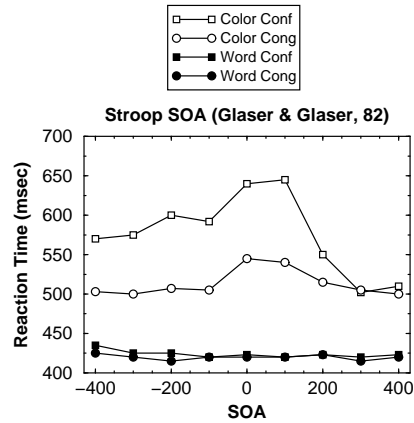
Congruent: Red



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Stroop Accounts

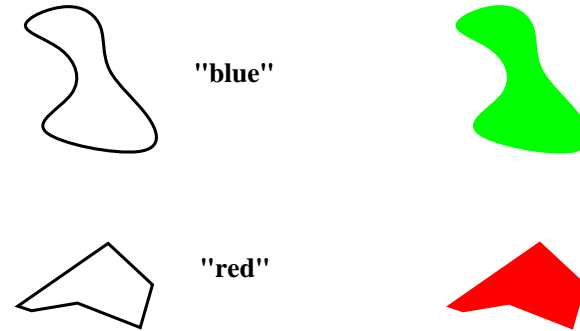
- Not a Horse Race



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Stroop Accounts

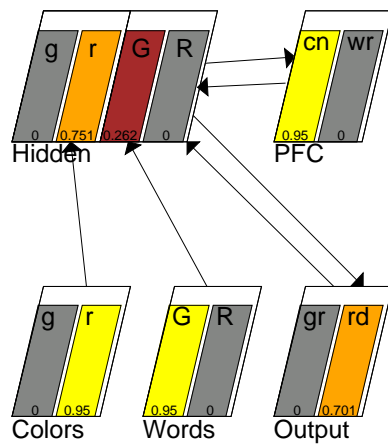
- Continuum, not a Dichotomy



Shape-naming first like color-naming in standard Stroop, then like-word reading.

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Stroop Model



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A Unified Activation-based Account

Central frontal mechanisms:

Activation-based working memory Frontal neurons maintain actively over delays.

Monitoring/evaluation e.g., Error-monitoring, critical for dopaminergic modulation.

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A Unified Activation-based Account

Inhibition Need to maintain top-down activation for weaker task.

Flexibility Dynamics of activation-based more rapid than weight-based.

Fluency Only problem w/ novel categories of responses — need top-down support to overcome prepotent categories.

Executive control Maintain & update plans / goals over time, avoid distraction.

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Beyond the PFC

Bias & Binding in the PFC and Hippocampus:

