Clinically-Relevant

How to Build a Cognitive Task

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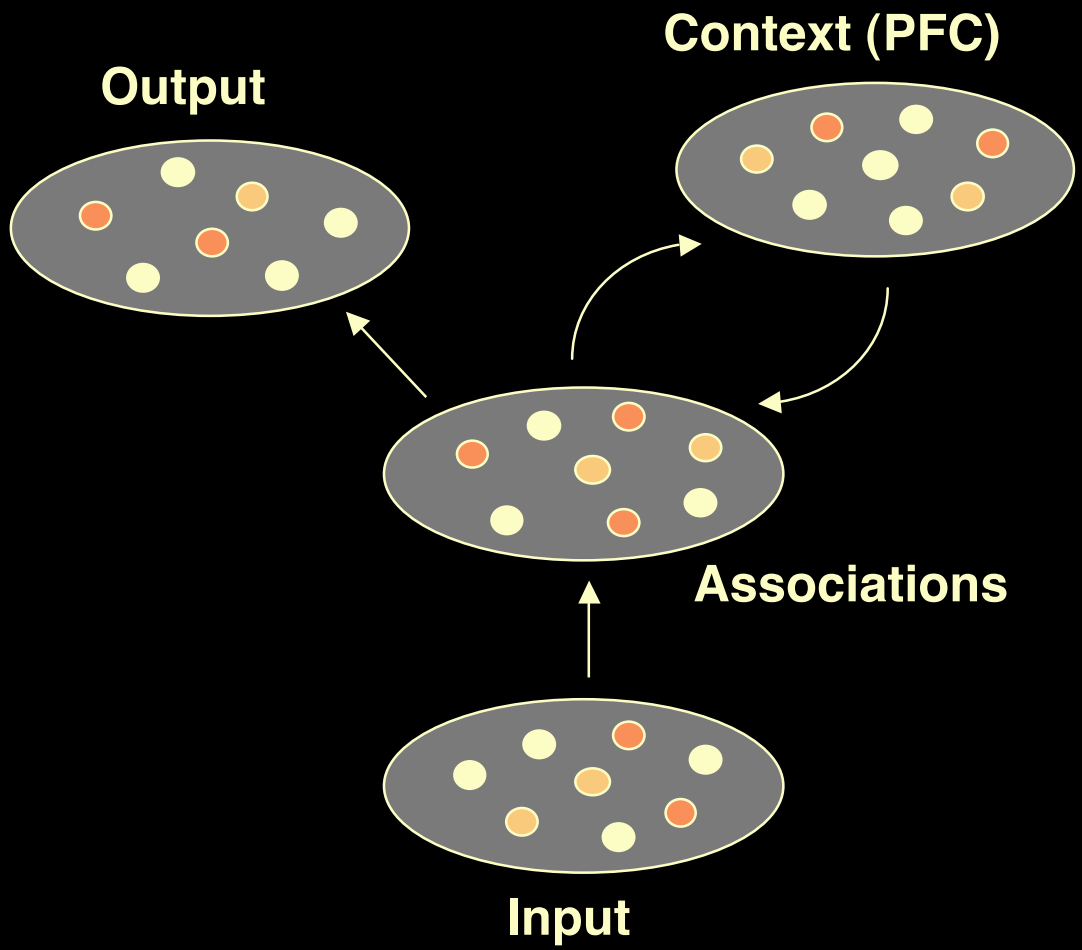
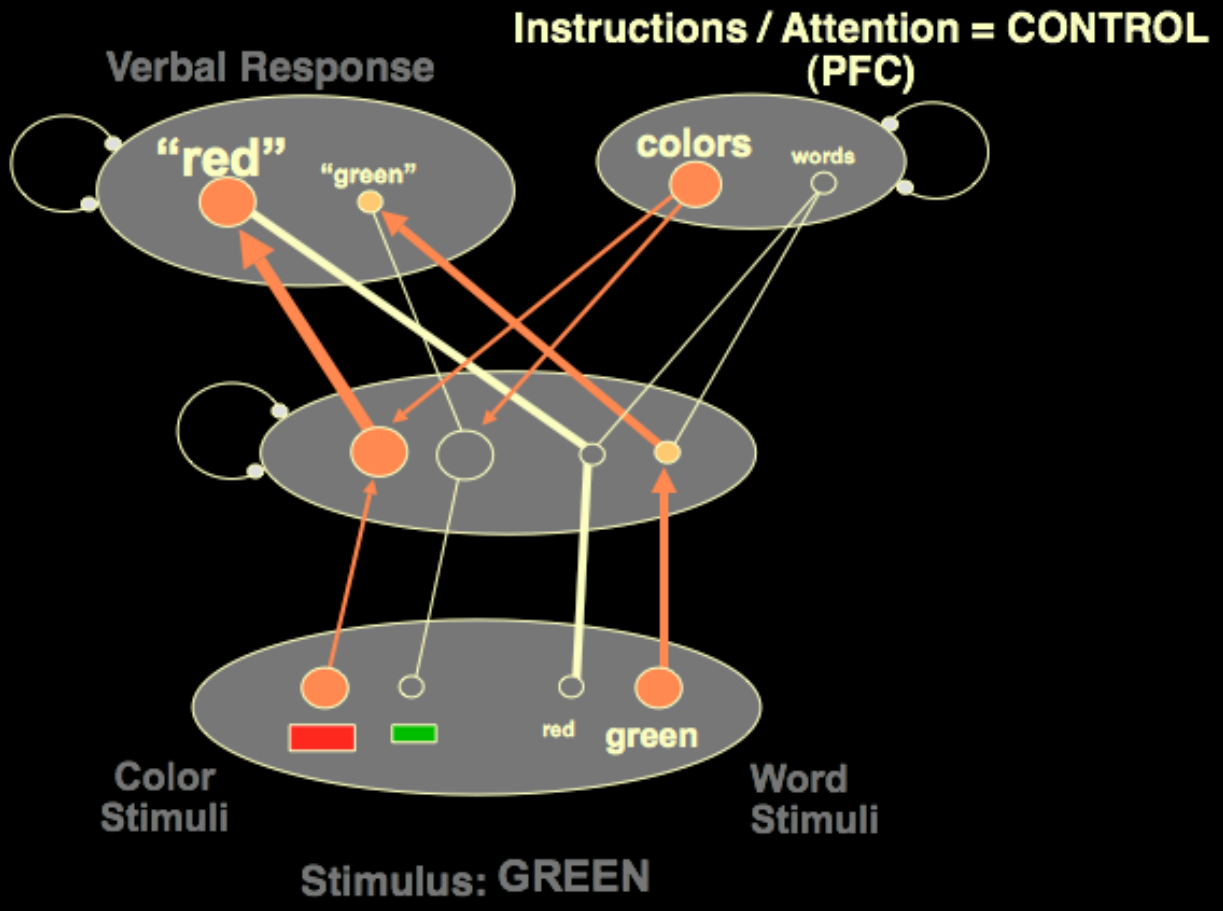
Example

- **What cognitive function(s) are impaired in schizophrenia?**
- **Evidence** (as of 1985):
  - **Disturbances of attention (Continuous performance task - CPT)**
  - **Disturbances of inhibition (Stroop task)**
  - **Disturbances of language processing (Cloze procedures)**
  - **Disturbances of working memory and executive function (WCST)**
- **Hypothesis:**
  - **The disturbances across a variety of task domains may reflect a common underlying disturbance in the processing of context…**

Context Hypothesis



Example: Stroop Task



Context Hypothesis

- **Attention:**
  - attentional selection relies on representation of context as a “template”
- **Inhibition:**
  - processing of task-relevant information relies on “top-down” support from context information to compete effectively with distractor information
- **Language processing:**
  - Virtually all lexical items are semantically ambiguous; representation of context is required for disambiguation
- **Working memory:**
  - active maintenance of context information in order to shape processing of subsequent stimuli
- **Executive function:**
  - active maintenance of goal information as context for guiding behavior

Testing the Context Hypothesis

- Problem with Stroop task:
  - increased interference could be due to selective or generalized deficit
- Design a novel task that:
  - specifically probes the processing of context
  - can distinguish a selective vs. generalized deficit

Design principles

- Contact with (foundation in) existing literature:
  - Try to keep it as close to existing task(s) as possible
- Simplicity
  - Pare it down to the simplest form that tests for the specified function
- Specificity
  - Include conditions that selectively manipulate specified function
  - Include controls for generalized deficit

Existing Literature

- **CPT-X** *(Rosvold et al., 1956)*

  - **Limited processing of context**
  - **Confounded with vigilance**

Existing Literature

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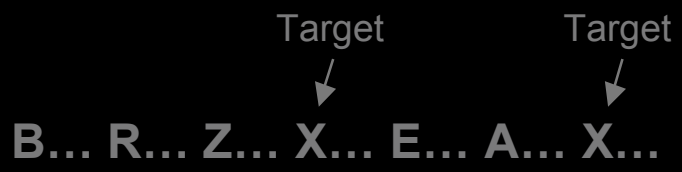

  - Limited processing of context
  - Confounded with vigilance

- **CPT-Double** *(Cornblatt et al., 1989)*

  - Simple case of context processing
  - Not optimally sensitive (no competing prepotent response)
  - No control for generalized deficits

Existing Literature

- **CPT-AX** *(Nuechterlien et al., 1984)*

  - Cleaner measure of context processing
  - Not optimally sensitive (no competing prepotent response)
  - No control for generalized deficits

Novel Task

- **CPT-AX** *(Nuechterlien et al., 1984)*

  - Relies on context processing
  - Not optimally sensitive (no competing prepotent response)
  - No control for generalized deficits

- **Modified CPT-AX** *(Cohen & Servan-Schreiber, 1990)*

Modified CPT-AX

- AX sequences: 70%
- AY sequences: 10%
- BX sequences: 10%
- BY sequences: 10%

High frequency of AX sequences induces:

Strong association of X with target response (prepotent response)

Strong association of A with target response to next stimulus

Modified CPT-AX

	Target response:
• AX sequences: 70%	Correct
• AY sequences: 10%	Context-induced error
• BX sequences: 10%	Prepotent response (context-fre
• BY sequences: 10%	Random responding

Modified CPT-AX

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- Manipulate delay between cue (A / non-A) and probe (X / non-X) to test for ability to maintain context

Modified CPT-AX

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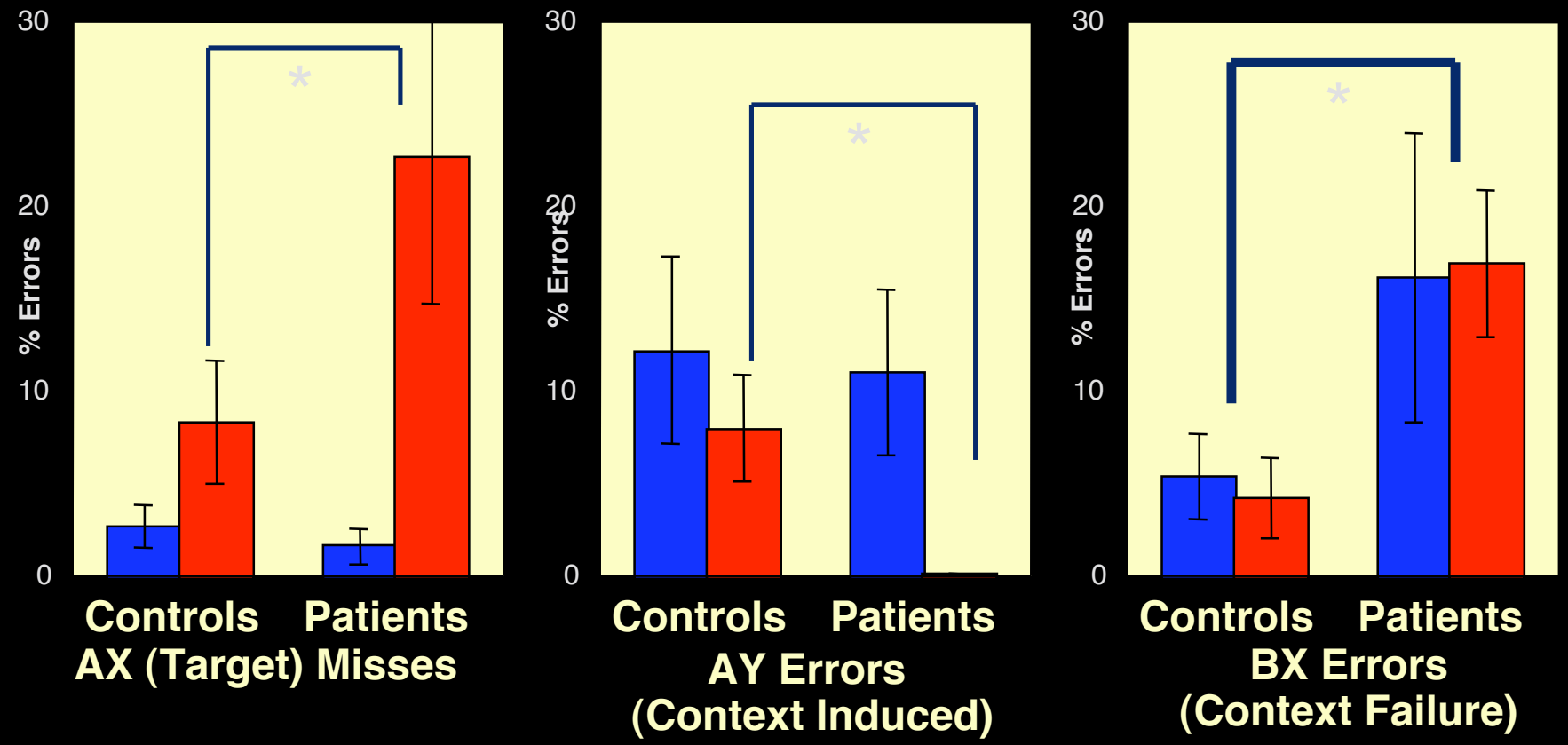
- **Predictions** (double dissociation):
  - Patient controls: more AY (context-induced) errors than other types
  - Individuals with schizophrenia:
    - more BX (context-free) errors
    - not more BY (random) errors
    - this effect will be evident at long but not short ISIs

Representative Findings

Double Dissociation



- **Participants**
  - 14 Medication naïve first episode patients with schizophrenia
  - 13 Demographically similar healthy controls

Summary

- Critical manipulations:
  - Frequency of AX sequences:
    - ability to use context to override prepotent response
  - Delay between cue and probe:
    - ability to maintain representations of context over time

Summary

- Critical manipulations:
  - Frequency of AX sequences:
    - ability to use context to override prepotent response
  - Delay between cue and probe:
    - ability to maintain representations of context over time

- Simplicity:
  - Simplest task that probes for ability to represent, maintain and use contex

- Specificity:
  - Control for generalized deficit (BX vs. BY errors)
  - Double dissociation: condition in which patients show improved performance relative to normal (AY sequences)
  - Deficits specific to a particular population (schizophrenia) vs. controls

Validation

- **Construct validity**
  - **Modeling work:**
    - **novel, quantitative predictions** *(Braver et al., 1996, 1999, 2000)*
  - **Correlation with convergent tasks** (*Cohen et al., 1999):*
    - **Stroop**
    - **Language context processing task (Missing Letter)**
  - **Imaging studies**
    - **involvement of prefrontal cortex (PFC) in normal participants** *(Barch et al., 1997)*
    - **Selective deficits of PFC in patients with schizophrenia** *(Perlstein et al., 2003)*
- **Stability**
  - **Test-retest reliability**
  - **Consistency across variants** (e.g., two-response version)

Challenges

- **Practicality**
  - it is long (45 minutes)
  - It is boring
- **Stability**
  - practice effects
  - test-retest reliability vs. sensitivity to state change
- **Standardization**
  - implementation
  - analysis