CENTER FOR MIND AND BRAIN

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Attention

Top-Down Control of Shifts of Attention

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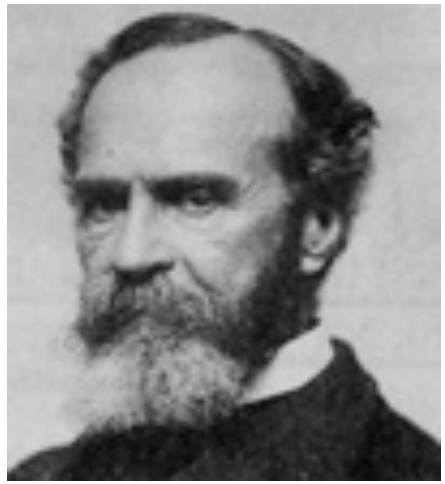
What is Attention?

- William James (1890)-



Everyone knows what attention is.

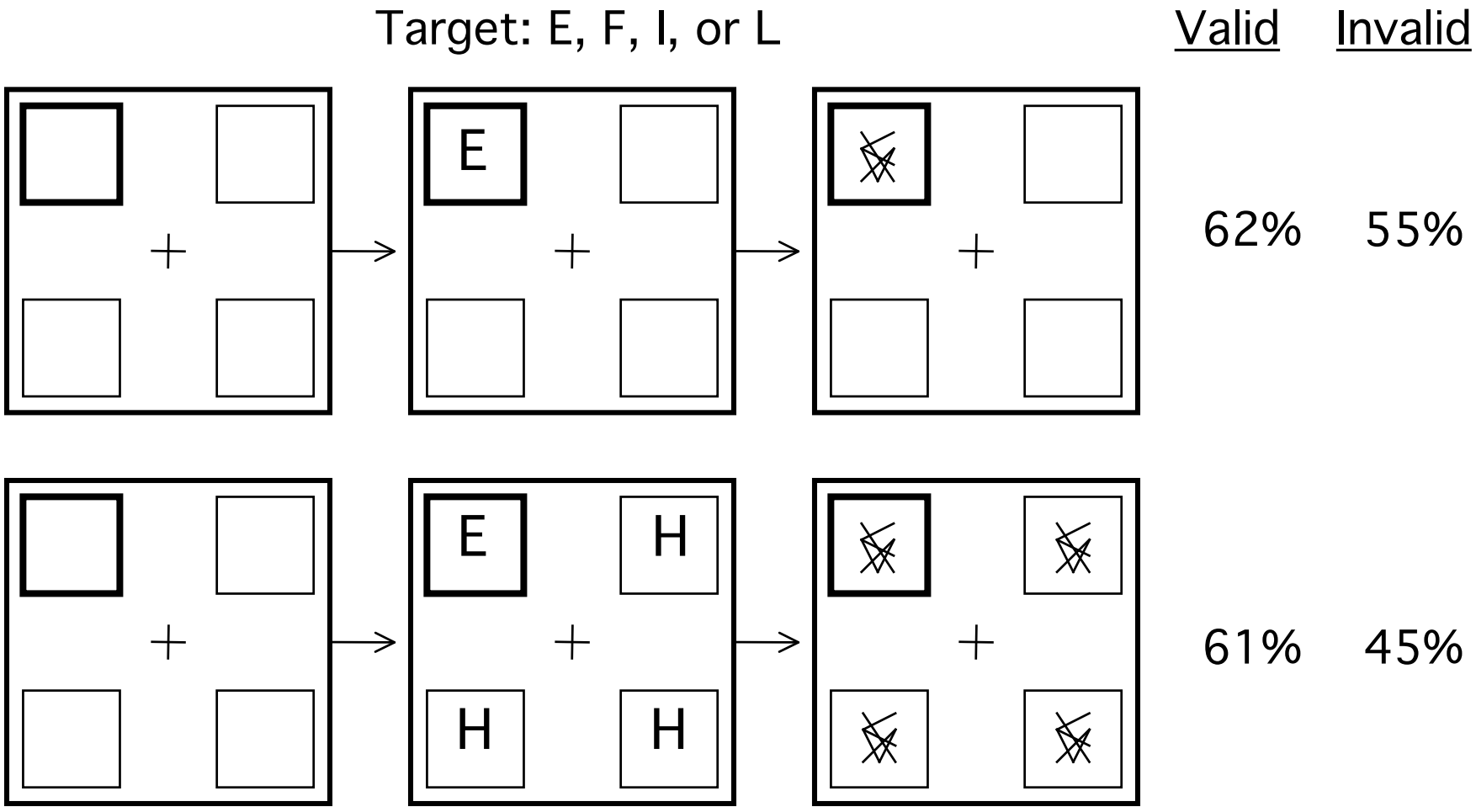
It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought...

It implies withdrawal from some things in order to deal effectively with others...

Attention as Input Selection

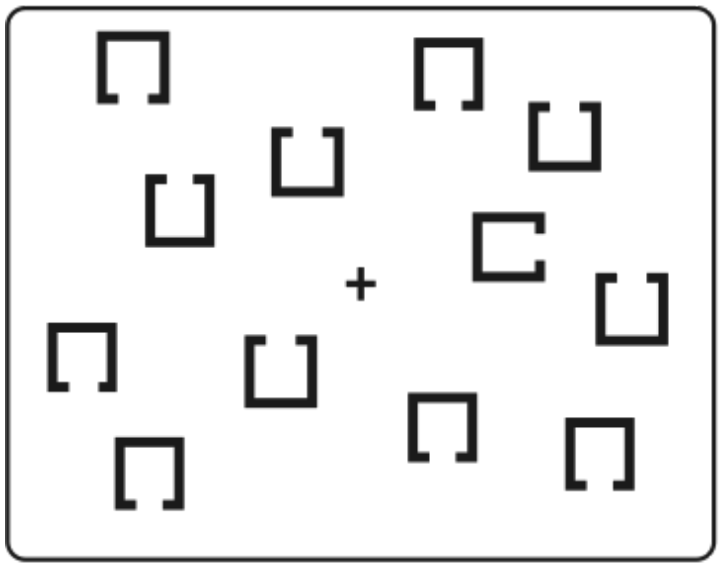
- Attention selects a subset of inputs for perception, memory storage, and action
  - "taking possession by the mind ... of one out of ...several ... objects or trains of thought..."
  - Unselected information is lost (or delayed)
  - "...withdrawal from some things in order to deal effectively with others..."
- Attention biases competition between inputs
  - Biggest effects when multiple inputs compete with each other
- Examples

Example: Spatial Cuing



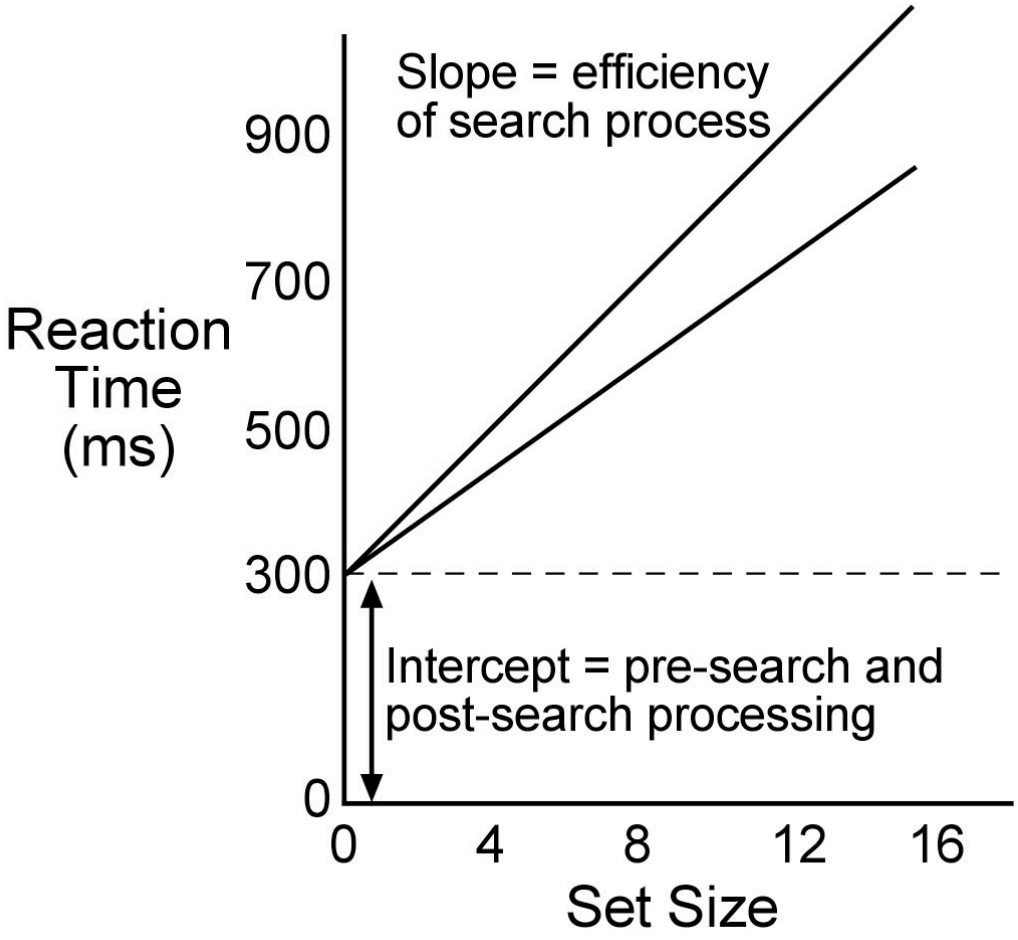
Luck & Thomas (1999)

Example: Visual Search



Target = ⊏ or ⊐

Set Size = 4, 8, 12, 16



Attention as Rule Selection

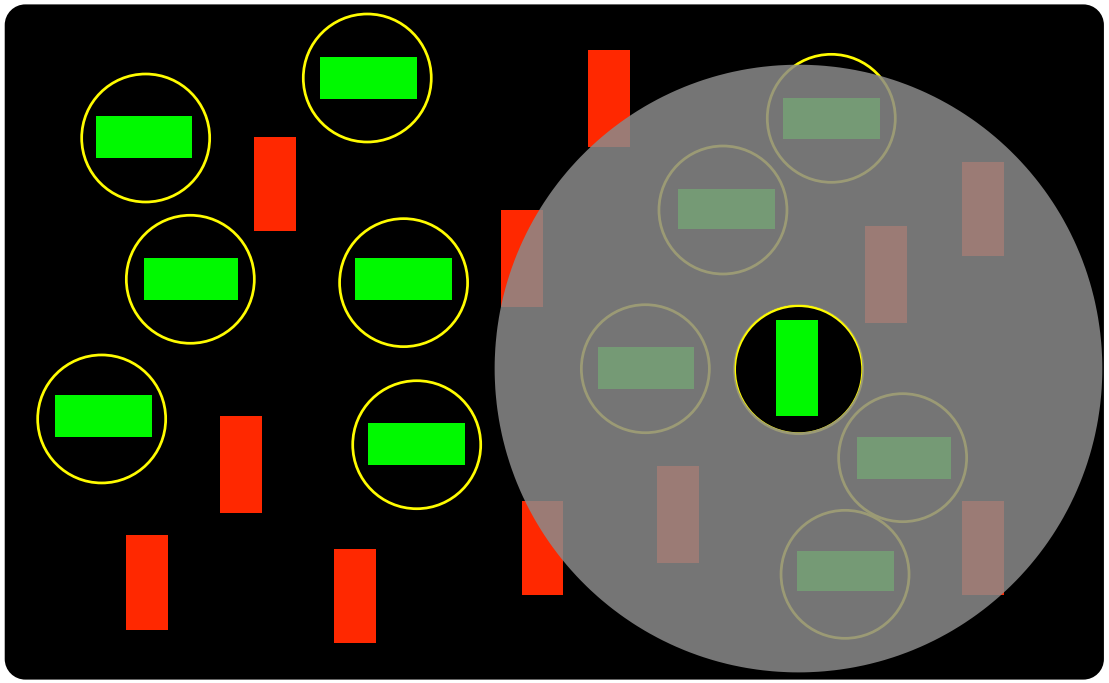
- Attention selects which rule to apply to an input
  - Stroop: Say word or ink color
  - AX-CPT: I just saw an A, so X is now a target
- We have donated rule selection to the executive control group
- Proposed division of labor
  - Attention → selection of inputs
  - Executive control → selection of rules
  - Working memory → storage and manipulation of selected inputs and rules

Control vs. Implementation

- Efficiency of input selection depends on two factors:
- Control of Selection- Finding the right input source
  - Getting the spotlight to shine on the right object
- Implementation of Selection- Boosting selected item and inhibiting competitors
  - The intensity of the spotlight
- Consensus at CNTRICS I: Control rather than implementation is a major source of impairment in schizophrenia
  - We haven't completely ruled out implementation, but it does not seem like a good target at this point

Example: Guided Search

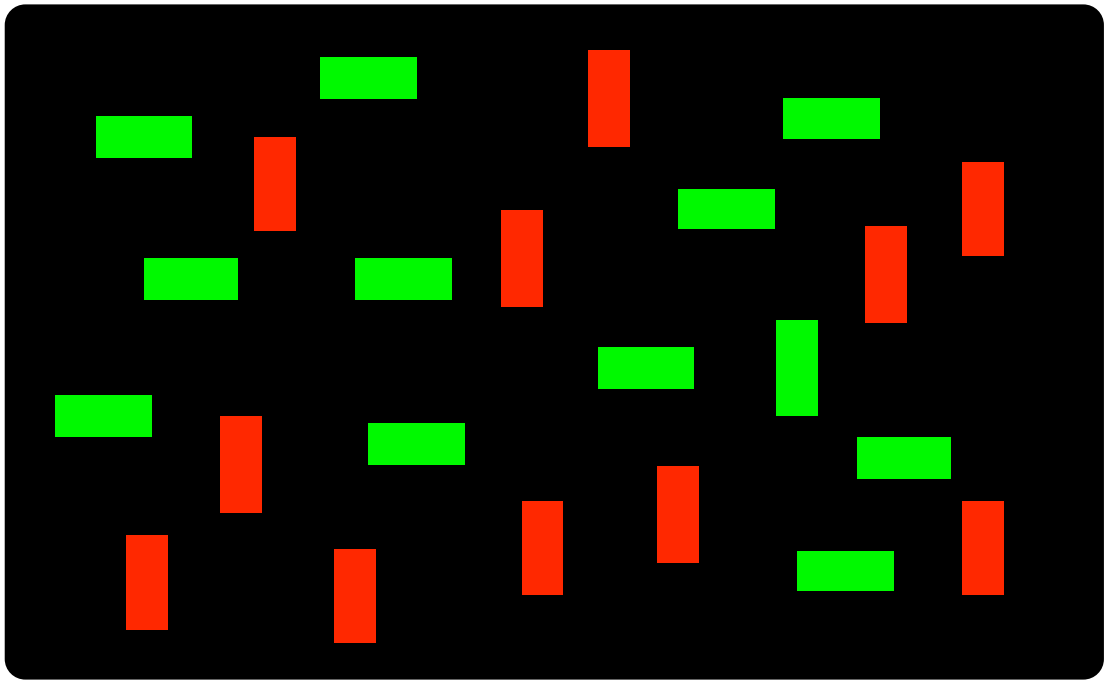
Search green bars to find one that is vertical



- Control- Limit search to green items
- Implementation- Filter out surrounding items to avoid misperceiving the orientation of a green bar

Example: Guided Search

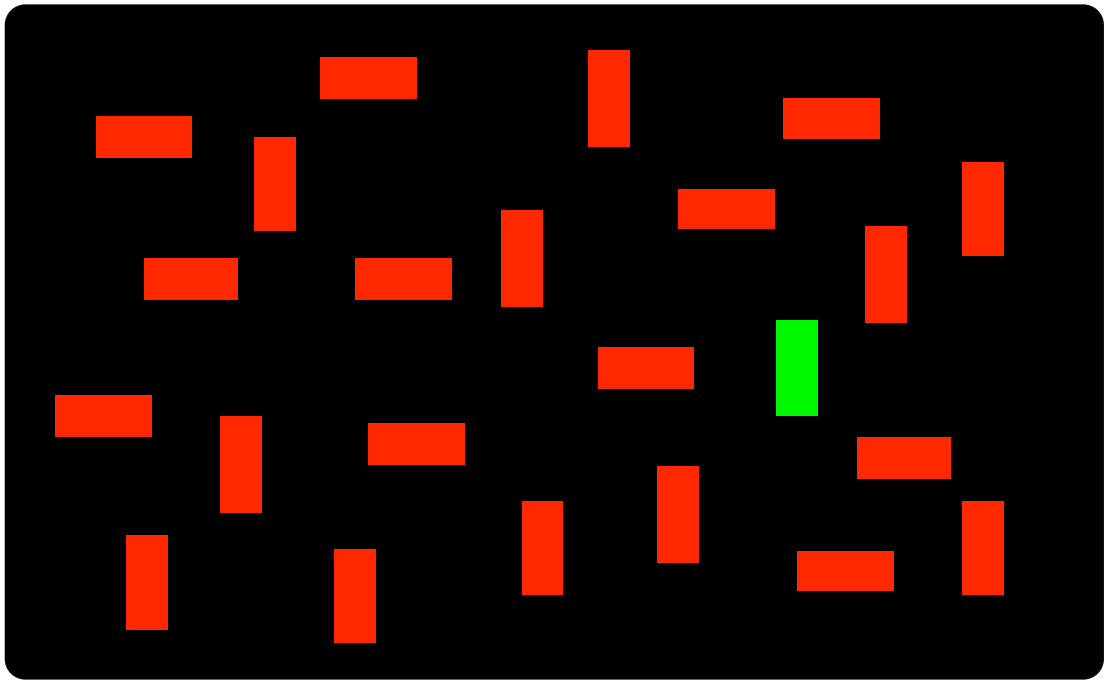
Search green bars to find one that is vertical



- This version requires substantial control
  - Red and green have equal bottom-up salience
  - Patients show significantly slowed search in tasks like this

Example: Guided Search

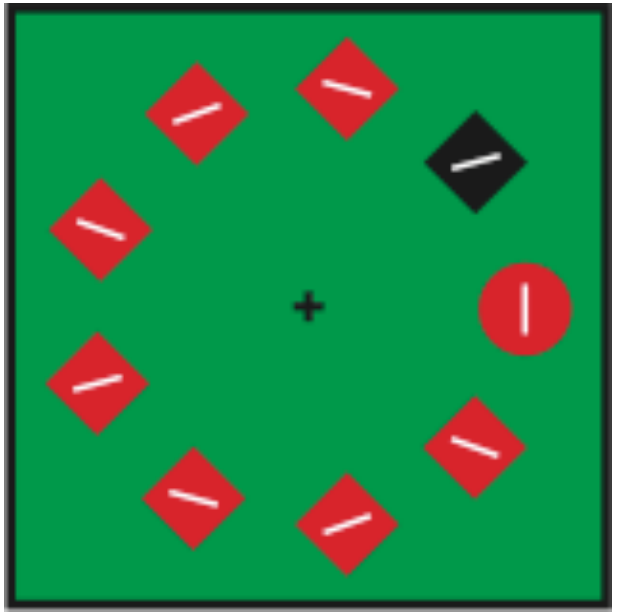
Search green bars to find one that is vertical



- This version requires minimal control
  - Green bar has high bottom-up salience
  - Patients do not show slowed search rates in tasks like this

Example: Singleton Capture

- Shifting to a target in the presence of a salient distractor
  - Task: Report orientation of line inside circle
  - One item is black on 50% of trials (never the target)
  - Pits controlled attention against bottom-up salience

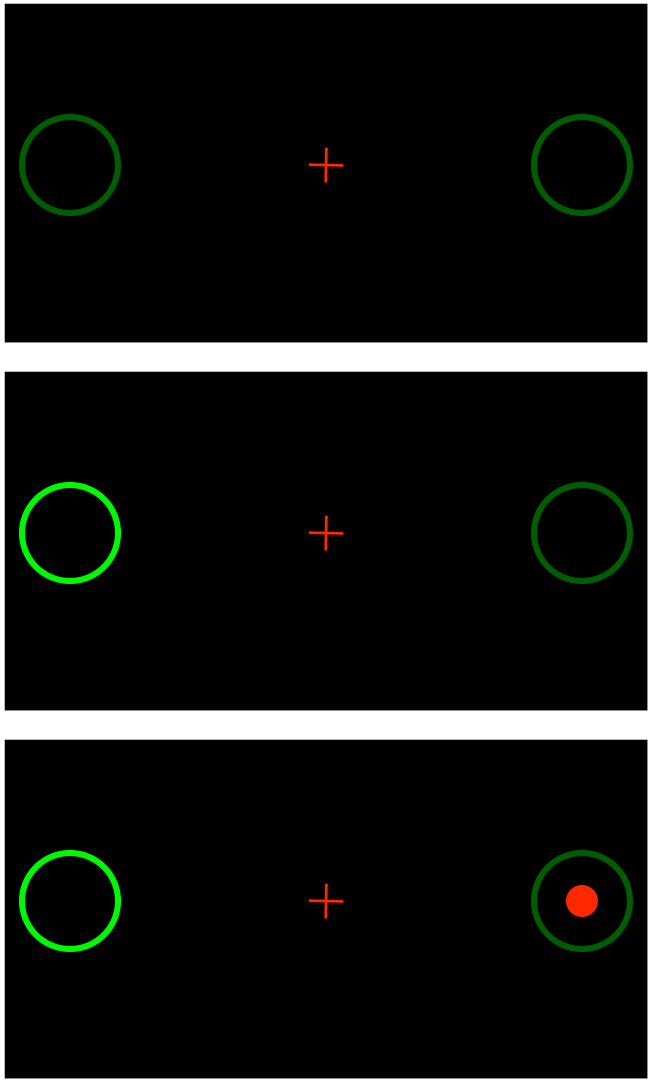


- Finding: Patients are dramatically slowed when the black item is present (but we're still working out the details)

Gold et al. (in prep.)

Example: Anti-Predictive Cues

- Shifting to a location opposite to a bottom-up cue
  - Like anti-saccade task, but with covert attention
  - Pro-shift: Target occurs at location of cue
  - Anti-shift: Target occurs at location opposite to cue
- Finding: Patients are slowed in the anti-shift condition



Maruff et al. (1996)

The Big Picture

- Proposed division of labor
  - Attention → selection of inputs
  - Executive control → selection of rules
  - Working memory → storage and manipulation of selected inputs and rules
- Input selection involves two components
  - Control of selection: Probably impaired in SC
  - Implementation of selection: Probably not impaired in SC
- Control can be assessed in tasks that either:
  - Pit bottom-up distraction against top-down control

    or
  - Compare efficiency of bottom-up and top-down control