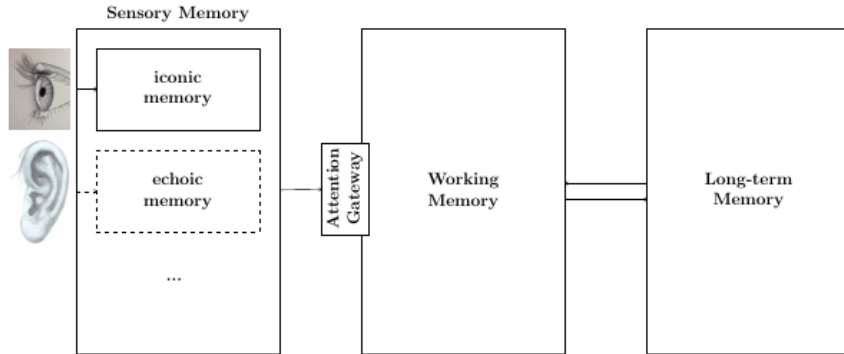# Biological Vision and Applications
Module 06-06: Short Term Memory

Hiranmay Ghosh

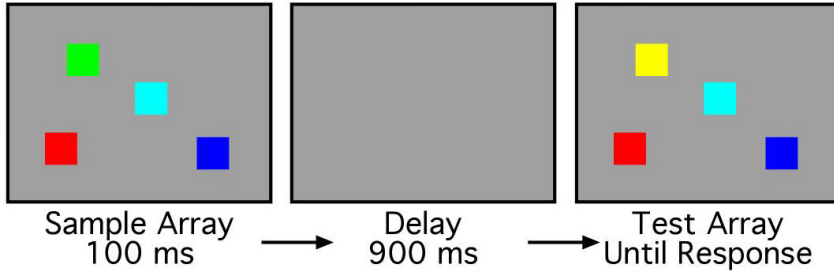# Memory pipeline for perception & cognition

- Memory is the key enabler for deliberation and learning in cognitive systems

Iconic Memory

- Holds visual information as icons
- Pre-attentive stage of vision
- Extremely short retention period
  - ▶ ≈ 100 ms
- Coherent representation of
  - ▶ Entire visual perception
  - ▶ For a very short time
- Leads to persistence of vision / motion blur
- The duration of visible persistence is <u>inversely</u> related to
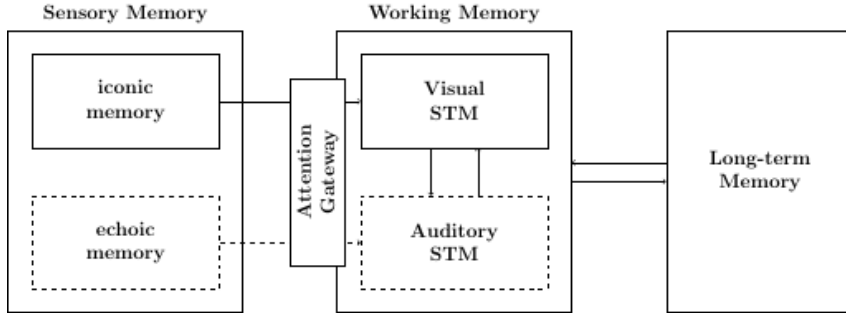 - ▶ Stimulus duration
  - ▶ Stimulus luminance

Iconic Memory & Change blindness

Sample Array
100 ms

Delay
900 ms

Test Array
Until Response

- The delay erases the memory

Working Memory / Short Term Memory

- Independence of visual and verbal tasks
- Further subdivisions in ASTM / VSTM ?

Working Memory vs Short Term Memory

- Short term Memory
  - ▶ Remembering something for a short while
    - ▶ ... e.g. a telephone number

- Working memory
  - ▶ Manipulating the contents of the memory
    - ▶ ... e.g. mental maths (adding two numbers)

- Interaction between STM and WM
  - ▶ Recall the numbers to add
  - ▶ Remember longer with mental rehearsal

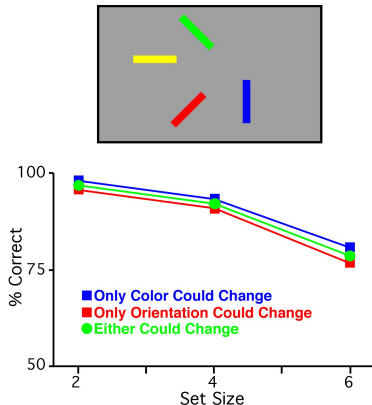- What is the representation of information in STM / WM ?

Visual Short Term Memory (VSTM)

- Retention period longer than iconic memory
  - ▶ Few seconds
  - ▶ Stores both "what" and "where"
  - ▶ Bridges sensory gap over saccades

- Rehearsal increases retention period
  - ▶ Repetition without interpretation (understanding)
  - ▶ In symbolic form ?
  - ▶ … sends information to LTM ?
  - ▶ (rote learning)

Scholarpedia article

Capacity of VSTM

- Small capacity: 3 – 4 "items"
  - ▶ Varied over individuals / experiments
  - ▶ Limit on volume of information, or number of objects ?
- How do we experience the plethora of objects around us ?
  - ▶ Just-in-time acquisition of needed information
- Multi-feature objects
  - ▶ Integrated object representation is stored
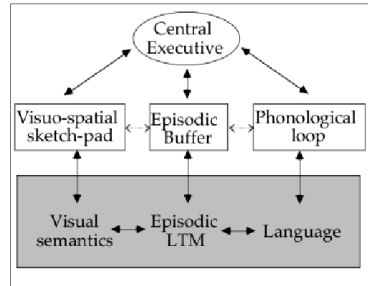 - ▶ Justifies object-based attention

Vogel. Storage of features, conjunctions, ... in visual working memory (2001)

Working memory

- Accessible for deliberative (goal-directed) information processing
- Central executive
  - ▶ Exercises attentional control over other components
- Visuo-spatial sketchpad
  - ▶ Create and maintain task-specific visual images
- Episodic buffer
  - ▶ Holds multi-modal information
  - ▶ Combines task-specific information from VSTM, ASTM and LTM

Scholarpedia article

Quiz

Quiz 06-06

End of Module 06-06