Chapter 3

Sensation and Perception

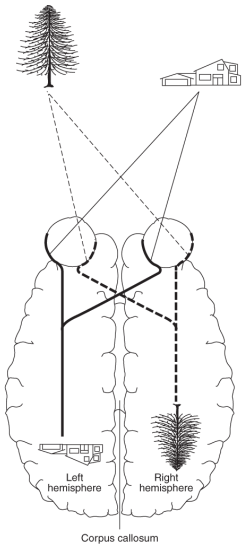
Sensation and Perception

- Visual Sensation and Perception
- Pattern Recognition
- Object Recognition and Agnosia
- Auditory Perception (skipped)

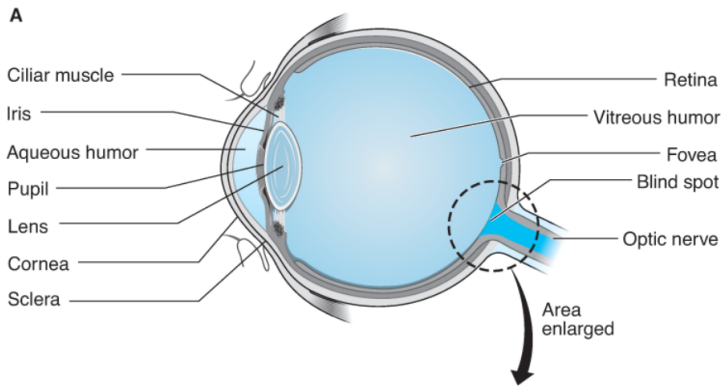
Visual Sensory Memory

Visual Fields

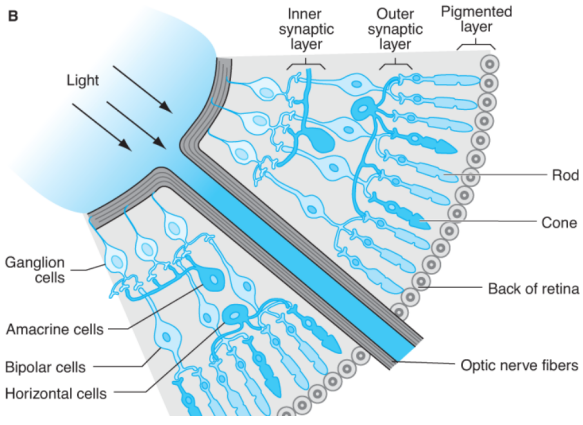
- Left visual field -> right hemisphere and vice-versa

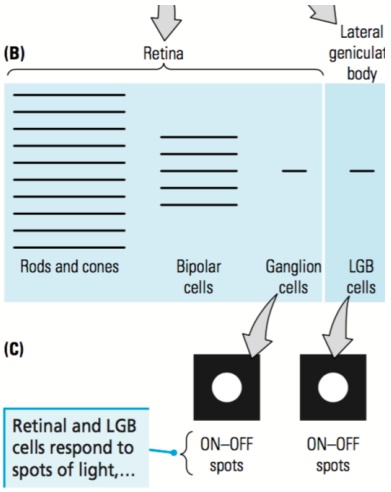


Human Visual System



Human Visual System

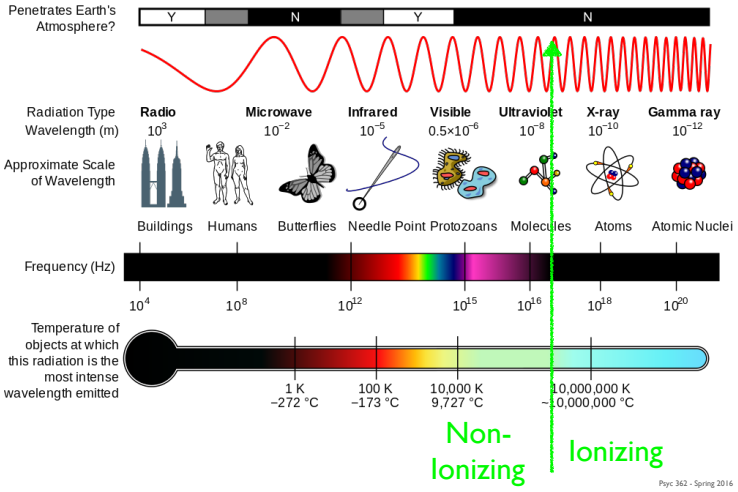




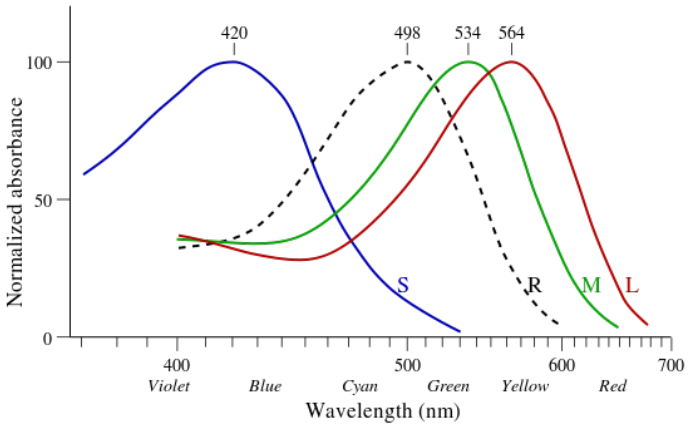
Loss of information / Simplification with levels

- Each subsequent layer has fewer neurons
- 120 million rods
- 7 million cones
  - most in fovea
  - synapse on 1 bipolar cell
- Peripheral vision:
  - 100 rods -> 1 bipolar cell

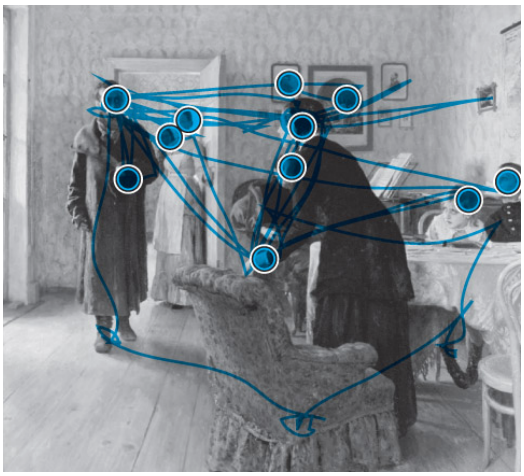
Electromagnetic Spectrum



Rods & Cones



Saccades



Saccades

- Saccades (fast movements)
- Fixation (eyes still)
- About 3-4 per second
- During Saccades, visual system is suppressed
  - change blindness

Visual Sensory Memory

- Show 12 items briefly
- Normal subjects report 4-5 items
- Stimuli duration not important
  - 5msec up to 500msec

- Sperling's experiment
  - Partial Report
  - 76% correct (out of 12) = about 9 items
  - Duration is important
    - after 1 second (1000 msec) 36%

Loss of information

- Passive
  - decay, “forgetting”
- Active
  - interference
  - backward masking

Interference

Sensory Memory: Motion & Time

- After 50msec fixation, a word can be changed without subject awareness (Rayner et al. 1981)
- Stimuli can contain motion - similar results (Finke & Freyd 1985)
  - sensory memory is not fixed snapshot
- Temporal Integration: Under 20 sec delay, items are seen as simultaneous (Loftus & Irwin 1998)

Pattern Recognition

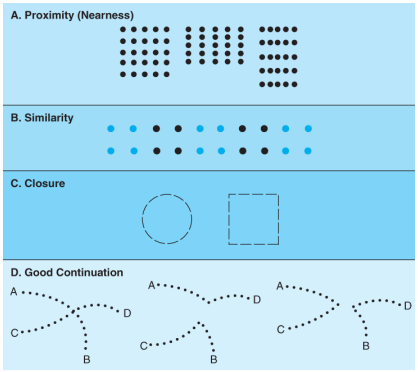
Pattern Recognition

- A process of solving a problem:
  - understand real-world from
  - retinal sensory data

Gestalt: Figure vs. Ground

Gestalt Principles

- Proximity
- Similarity
- Closure
- Good Continuation

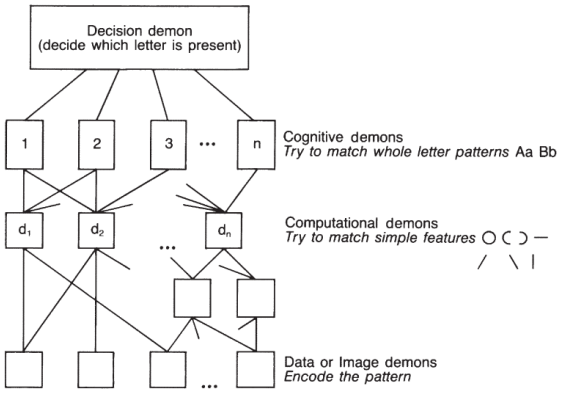


Recognition by Templates?

- Brain stores all possible variations of an object
- Impractical and probably not how the brain works.

Feature Detection

- Pandemonium model (Selfridge, 1959)



Feature Detection Models

- Layers (from low level features to high level conceptions)
- Parallel Processing
- Biological reality
  - e.g. Area 17 aka V1 in brain
- Summary: better than Template Models
- But
  - still purely Bottom-Up (Data-Driven)

Conceptually-Driven Processes

- AKA "Top-Down"
- Explains Context Effects

Jack and Jill went up the hill.

The pole vault was the last event.

Jack and Jill went up the hill.

The pole vault was the last event.

Perception under Conscious Control?

- Conscious vs Unconscious influences…

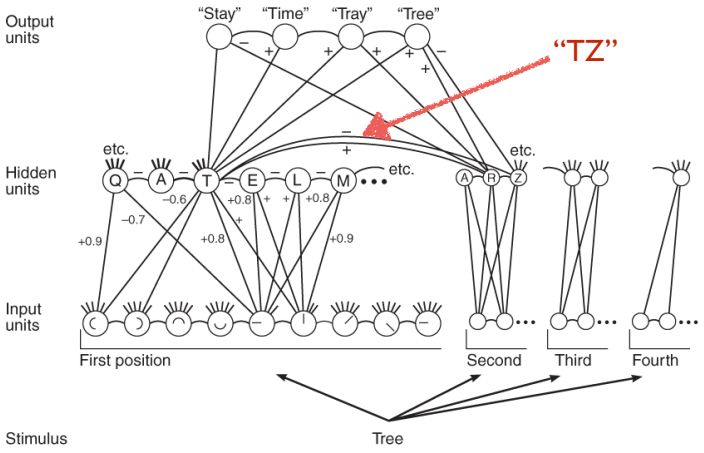
C. Search for *K*

ODUGQR
QCDUGO
CQOGRD
QUGCDR
URDGQO
GRUQDO
DUKGRO
UCGROD
DQRCGU
QDOCGU
CGUROQ
OCDURQ
UOCGQD
RGQCOU
GRUDQO
GODUCQ

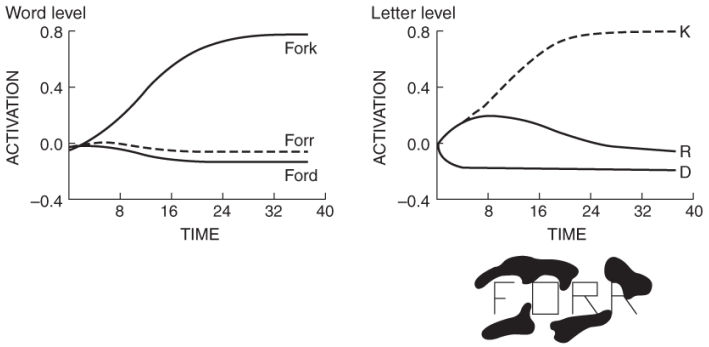
Connectionist Models

- Parallel ("massively parallel")
- Distributed
- Layers (often 3)
  - Input
  - Hidden
  - Output
- Units
  - positive, negative excitation
  - multiple inputs, one output
- Neural Network Modelling

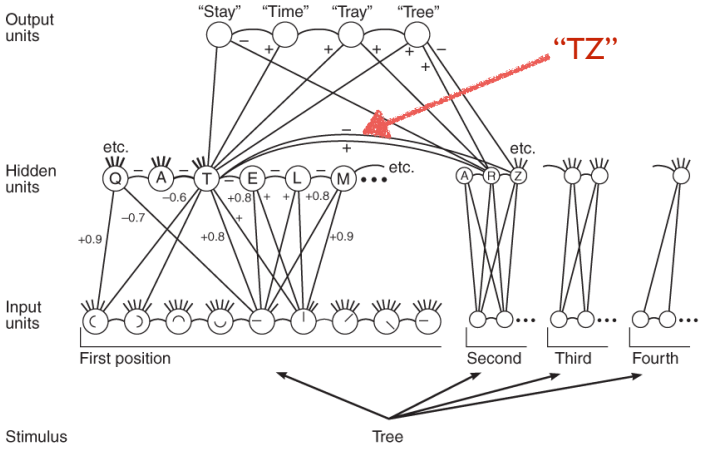
"Tree"



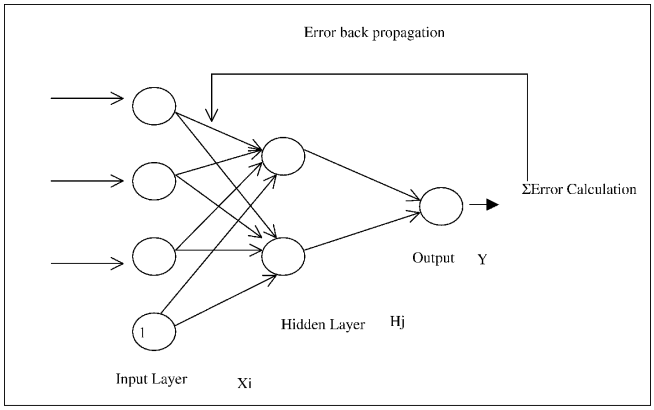
Mimics Biological Performance



"Tree"



How to train your dragon



Notes: The weight connecting node *i* in the input layer to node *j* in the hidden layer is denoted by *Wji*, and the weight connecting node *j* to the output node is represented by *Vj*

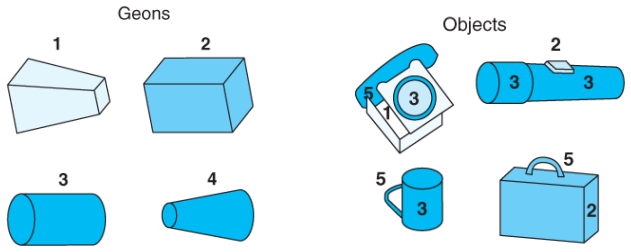
Neural Network Training

- The Delta rule
  - weights are adjusted by the amount of error
- Back Propagation
  - "Backward propagation of errors"
  - delta change changes go backwards from output layer to input layer

Object Recognition and Agnosia

Recognition by Components

- Theory: complex objects are recognized by parts
- Geons (geometric ions)
  - primitive geometrical forms



Evidence for RBC

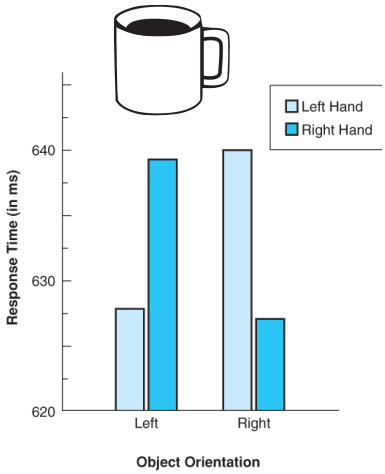
- Degraded patterns
  - where is important
- Recoverable vs. Non-Recoverable items

Evidence against RBC

- Speed: can recognize whole faster than parts
- Neuroscience: agnosia - loss of gestalt but retain RBC

Embodied Cognition

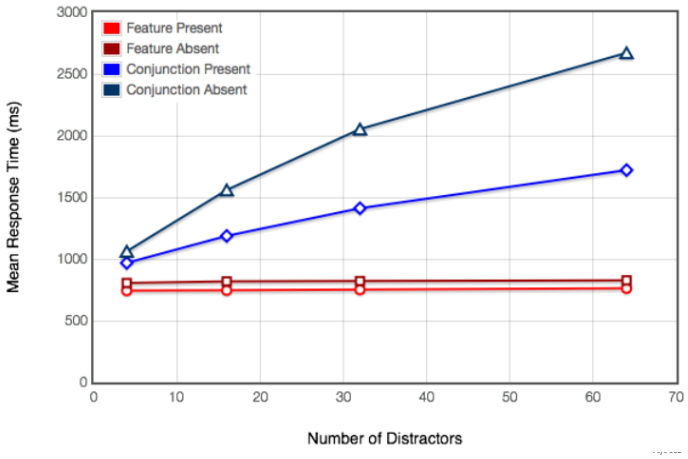
- When looking at or thinking of object…
- Neurons in motor and sensory systems show activity, as if a person was touching or using the object.



CogLab 3:Visual Search

- TBD

Visual Search: Global Data



Visual Search: Our Data

- TBD

Visual Search

- TBD

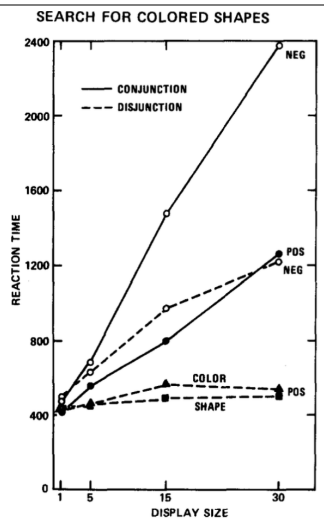


FIG. 1. Search times in Experiment I.

Visual Search

- Debriefing
  - Methods?
    - feature search
    - conjunctive search
  - Predictions
    - Feature Search: RT independent of N
    - Conjunctive Search:
      - present : varies with N
      - absent: varies with 2xN (exhaustive search)
  - Robust? Limitations?

Clinical Syndrome: Agnosia

- A - lack of
- Gnosis - knowledge
- Agnosia
  - Visual Object Agnosia
    - typically Left Hemisphere Damage
  - Prosopagnosia
    - Prosopos : face
    - typically Right Hemisphere Damage

Eyes Right!

- Mrs. S in her 60s, massive stroke affecting deep/posterior right cerebral hemisphere
- Can not see items to her left
- Can not conceive of going to the left
- Goes left by making 3 right turns
- “Hemi-inattention”

The man who mistook his wife for a hat

- Dr. P, professor of music
- Inability to recognize faces
  - could recognize voice
- Couldn't tie own shoes
  - "That is my shoe?" (pointing to foot)
- Couldn't recognize object Gestalts
  - "A continuous surface, infolded on itself, five outpouchings" (Glove)
- Compensation
  - songs for life activities