Perceiving Function and Category

Perception of Function

Determining **function** along with perception.

Evolutionary utility of vision - perceiving **function**

Can I eat this object?

Can this object provide shelter?

Can I wear this object?

Two major theoretical approaches

1) Affordances

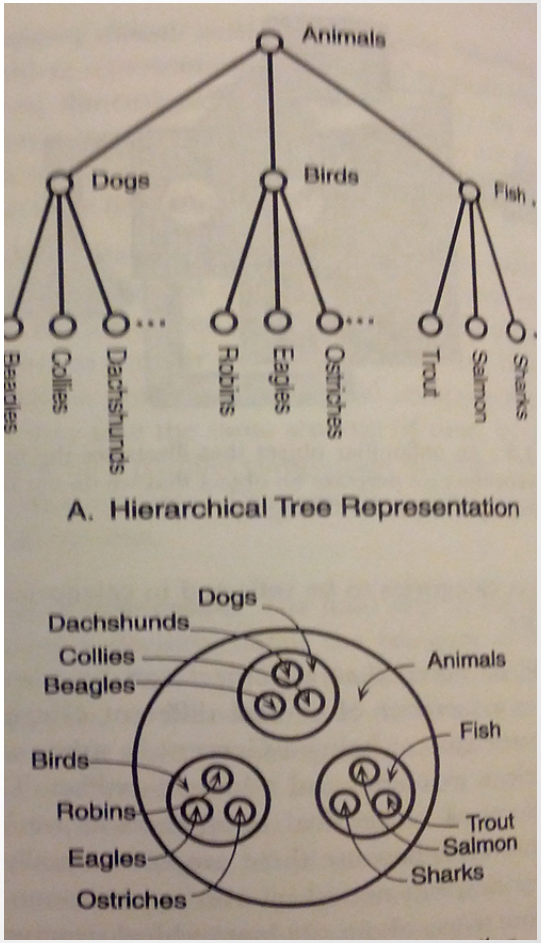
direct or unmediated method of perception proposed by James J. Gibson.

+Perceive function of an object through its physical or inherent state once you see it

Two major theoretical approaches

2) Categorization indirect or mediated approach.

+Function is known by retrieving associations between object category and its known users



Perception of affordances

- Gibson passed away before developing his ideas further.

- The field is dominated by categorization

Direct Perception of Affordances

- Gestalt psychologists propose affordances of objects ***could be perceived directly.***
- Opposed to associating an object with a category that exists in the mind.
- **Physiognomic character of perception**

Direct Perception of Affordances

Functional form

- relation between object forms and affordances

-*how the function is transparent*

example: height, stability, 'sittable' surfaces

Observer Relativity

+functional properties *in relation* to observer.

+An object's affordances may not be the same between an adult and a child

Direct Perception of Affordances

Physical affordances

-Objects' physical structure that enables these functions

-Most direct

-Not all objects are like this

-Consider: Mailbox vs Trashcan

Affordances can be misrepreseneted

+nonvisual info at odds with visual info


TRASH

Direct Perception of Affordances

Goodale and Milner proposed two visual systems in terms of 'what' vs. 'how system.

Ventral System -Identifying objects purpose and high level planning of actions

Dorsal System - for executing voluntary action (grasping) and other visually guided tasks

Patient example: these systems work more closely together

Indirect perception of function by Categorization

Four components of Categorization

1) Object representations
2) Category representations
3) Comparison processes
4) Decision processes

Theories of how categories are 'matched'

Threshold rule

-Matches objects with categories in which objects exceed the threshold value

-Identifies *novelty*, fails at *uniqueness*

Maximum (best fit) rule

-Chooses which category has highest 'best fit' values.

-Assigns *uniquely*, but cannot recognize *novelty*

A combination of theories

Maximum over threshold

-Set a threshold below which objects will be perceived as novel, but above which category with highest value is chosen.

-A good mix!

Phenomena of Perceptual Categorization

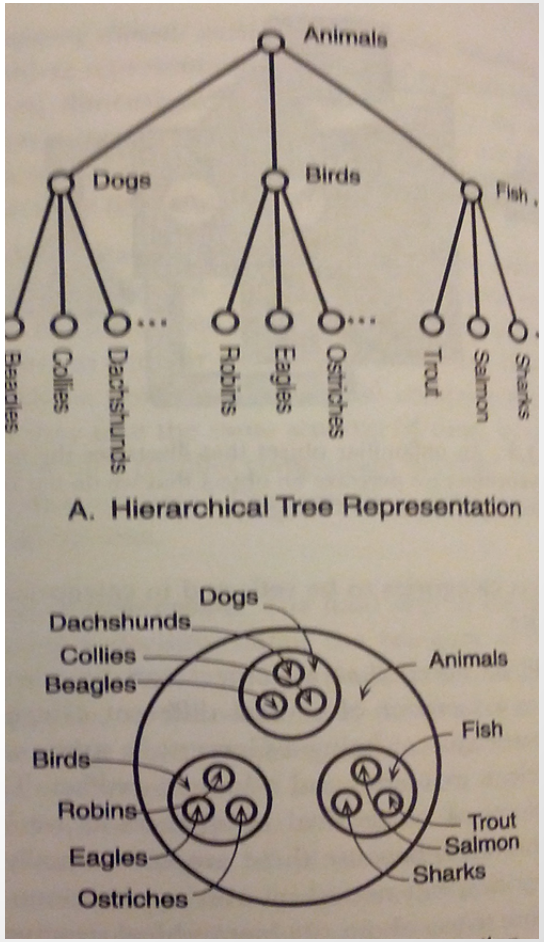
Categorical Hierarchies

Objects can belong in one or more category.

Need a way to organize these categories

-Hierarchy

-Venn Diagrams



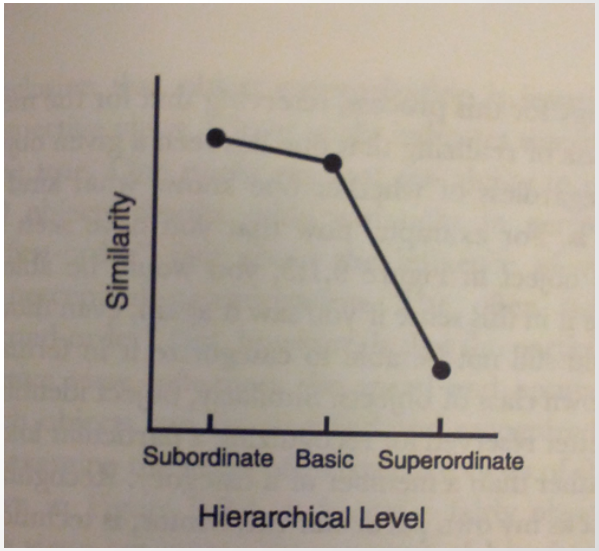
Category Hierarchies

Basic Level Categories

-The 'intermediate' level in the categorical hierarchy.

Above basic: superordinate

Below basic: subordinate



-Similar shape

-Similar motor interactions

-Common attributes

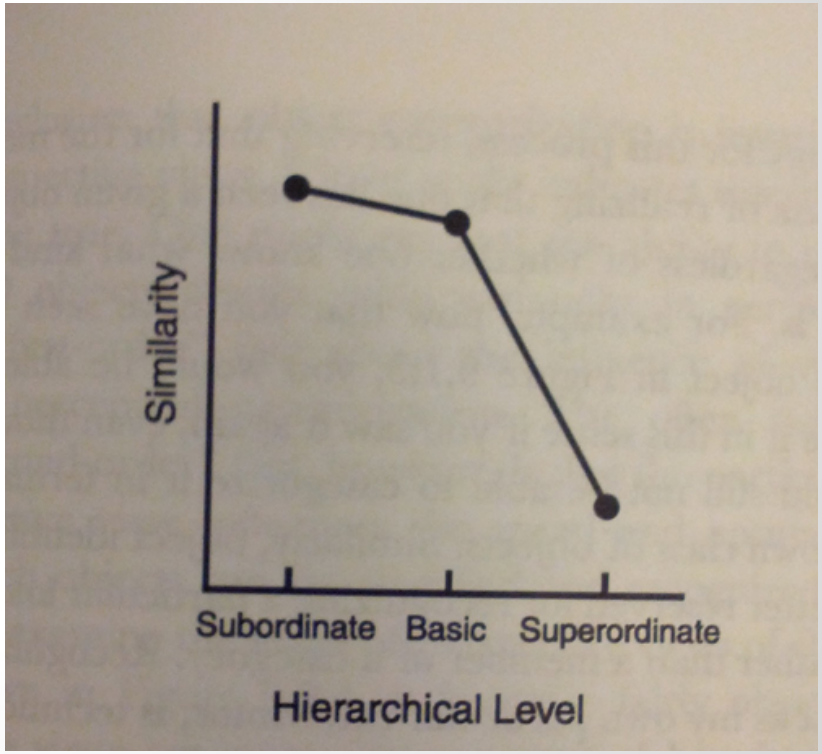
Category Hierarchies

Entry level hierarchies

Atypical objects are classified at a subordinate level

+Not universal for all atypical objects

+Mostly for categories whose *basic levels* are diverse.



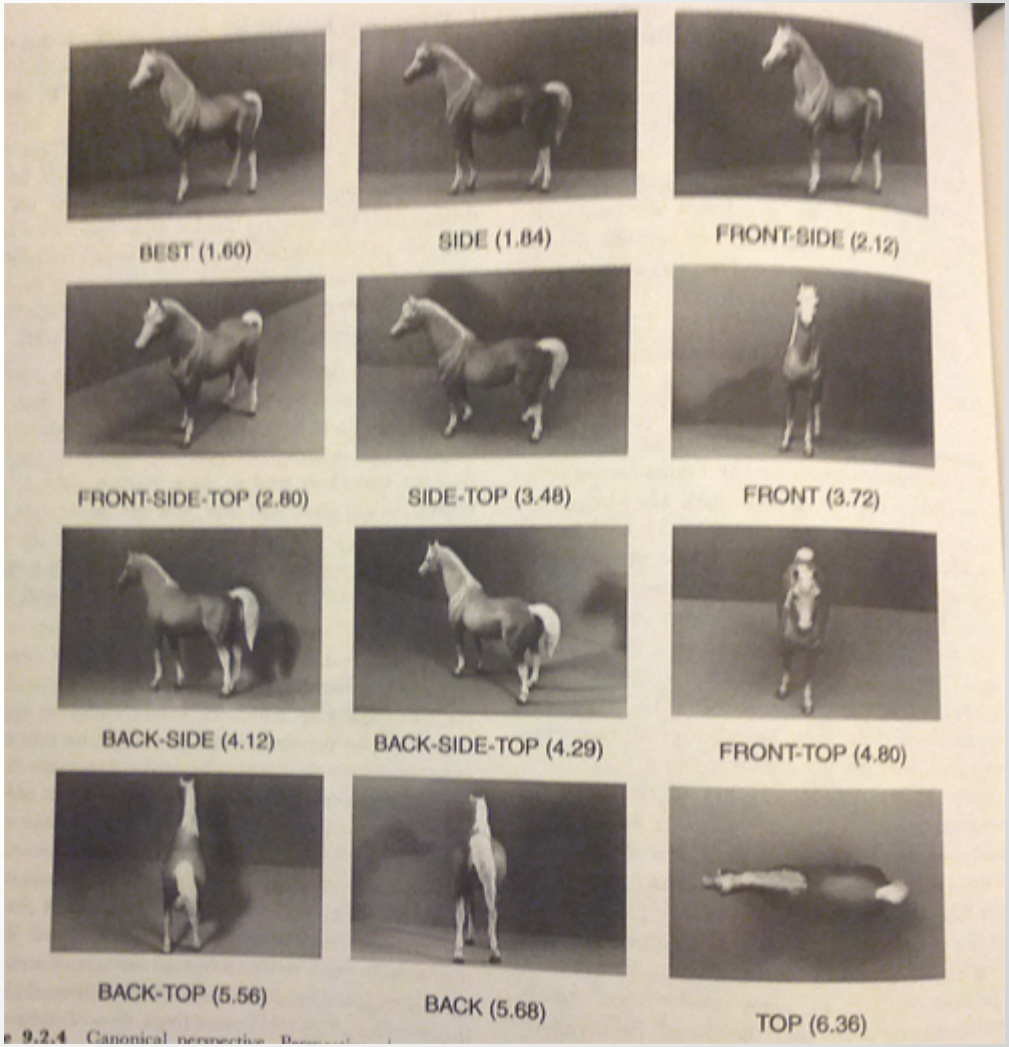
Perspective Viewing conditions

Canonical Perspective

-The most easily identified view for each object

a) Frequency hypothesis

b) Maximal information hypothesis

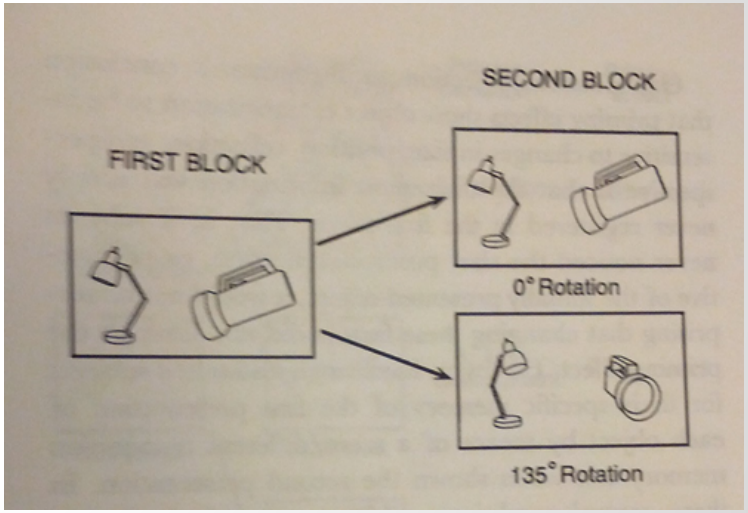


Perspective Viewing Conditions

Priming effects

+Introduce an object earlier

+Can identify the object more quickly later on



Orientation Effects with priming effects

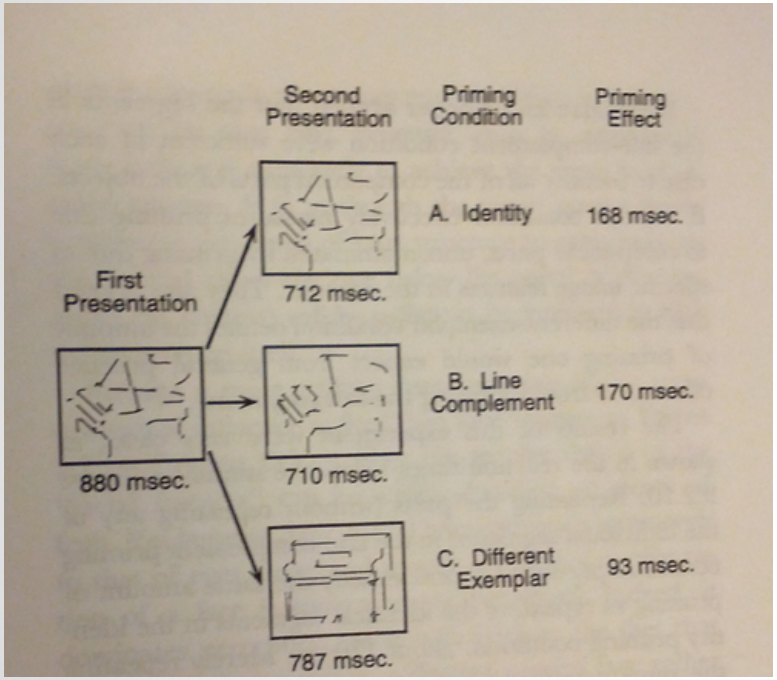
Various orientations do not diminish priming effects

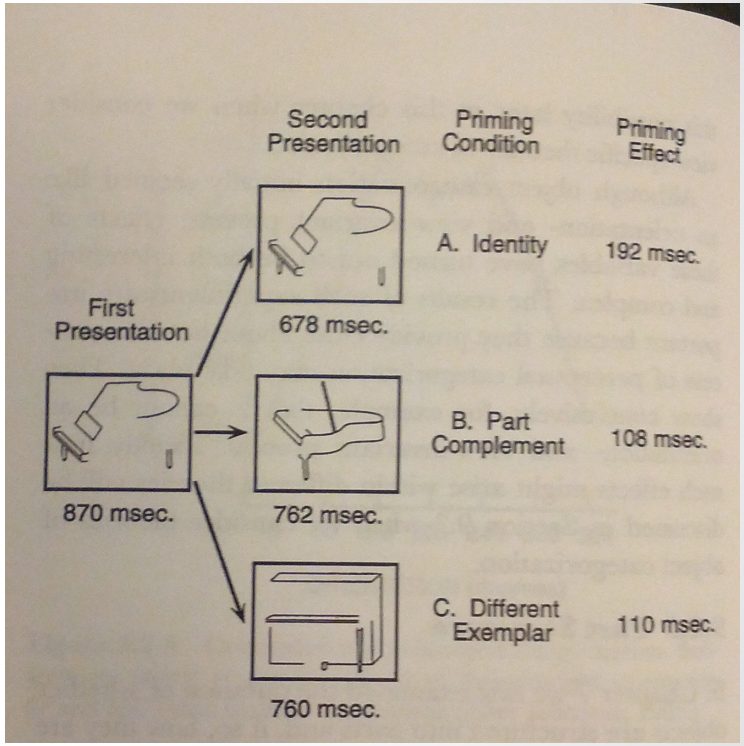
Part Structure

1) Identity Priming
2) Line Complement priming
3) Different exemplar priming

(picture experiment)

Object categorization based on perception of parts rather than individual lines.





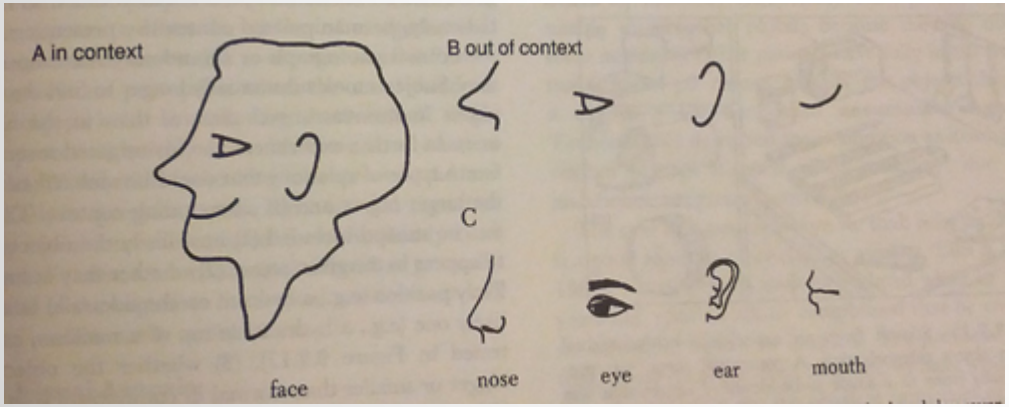
lines/contours

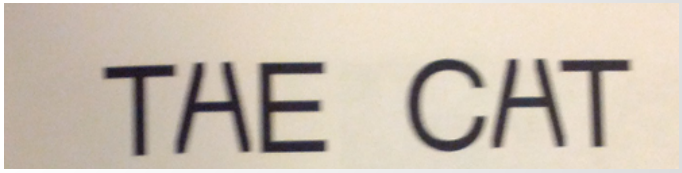
Parts

Contextual effects

+Changes categorization performance

+Due to spatial arrangement of objects surrounding the target object





Visual Agnosia

Perceptual deficit due to brain damage in which patients are unable to correctly categorize objects from which they were previously familiar.

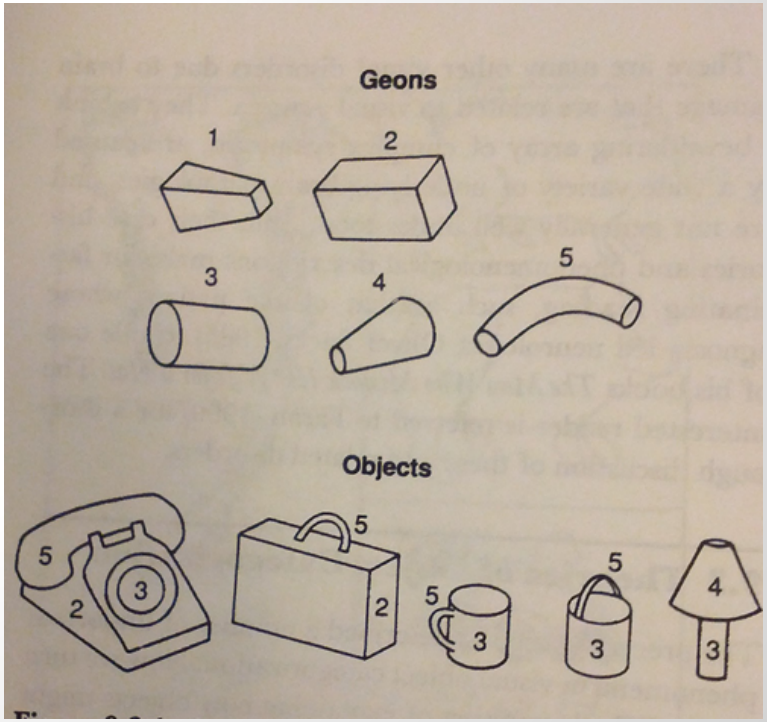
Associate agnosia - cannot identify objects despite still 'perceiving' them.

Theories of Object Categorization

Geon Theory

Geons

-Cross sectional curvatures
-Symmetry
-Axis Curvature
-Size Variation
-Aspect Ratio



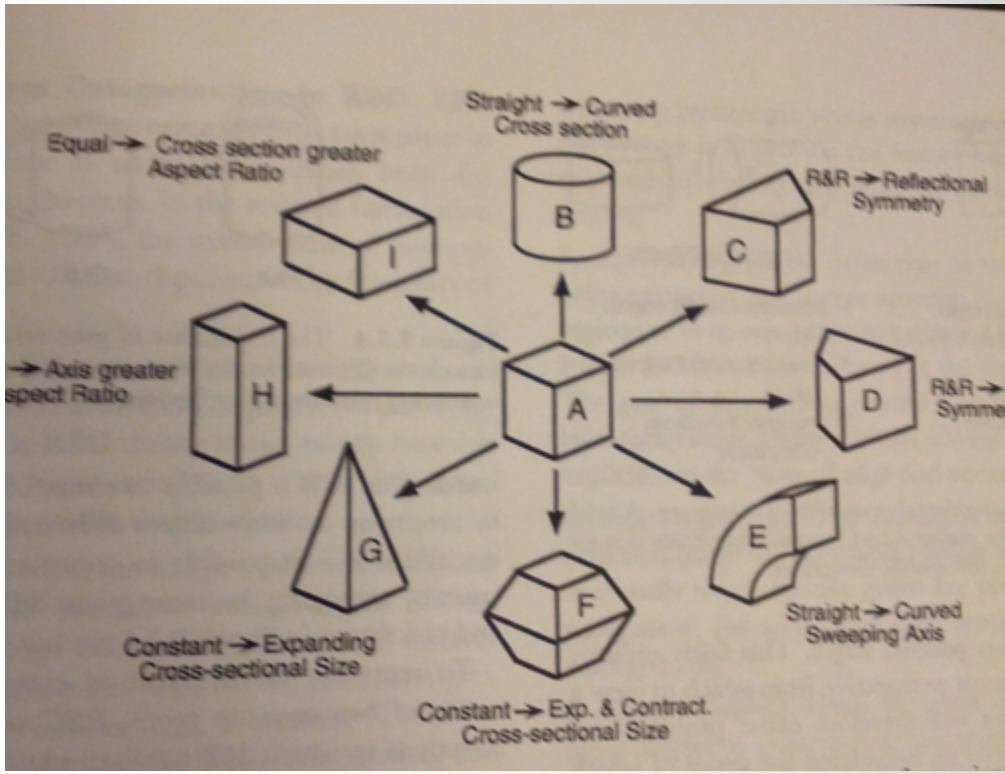
Recognition by Components Theory

Nonaccidental features

Geons are identified as having nonaccidental features.

Accidental features depend on 'rare accident' viewpoints.

EX: Viewing a brick from the side



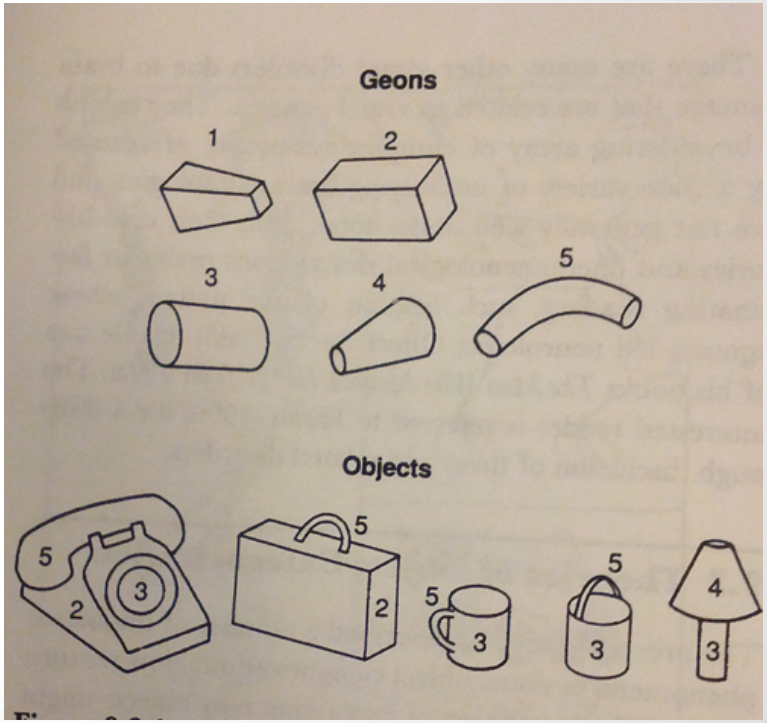
RBC Theory

Geon Relations

represented by structural descriptions

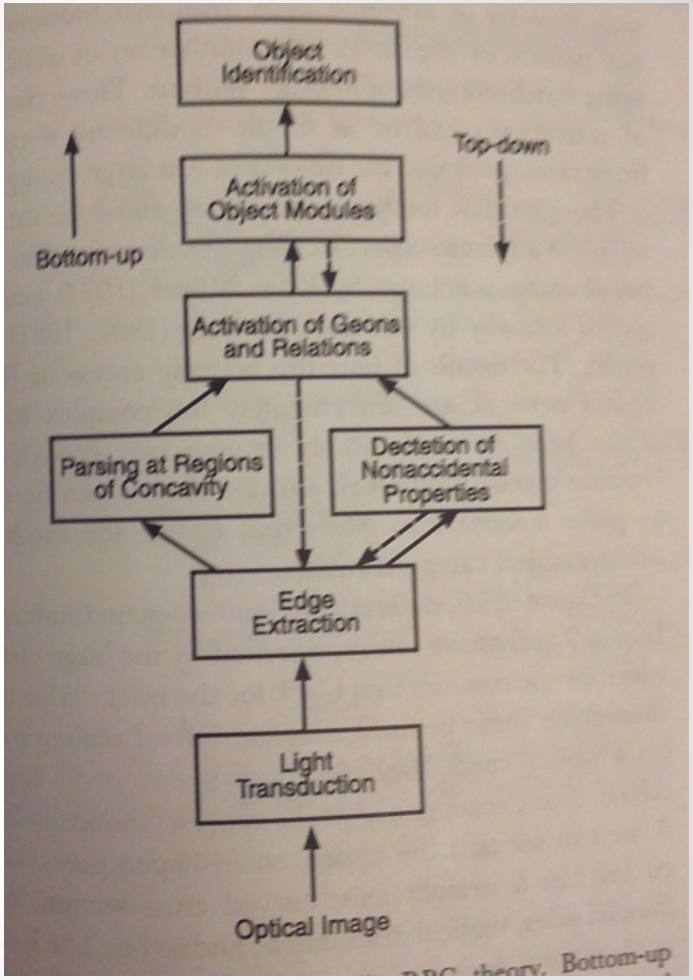
ex: SIDE CONNECTED, TOP CONNETED

LARGER THAN, SMALLER THAN



Stages of Object Categorization in RBC

1) Edge Extraction
2) Feature Detection
3) Object Parsing
4) Geon Categorization
5) Category matching
6) Object Categorization



Can be reversed

Involving feedback from geons

Accounting for empirical phenomena with RBC

Entry-Level Categories
Viewing Conditions
Part Structures

Cannot explain well
Contextual Effects
Visual Agnosia

Problems with RBC

1) Lack of representational Power
2) Geons do not capture every subtle different
3) Need more discriminative powers to distinguish between more subordinate categories
4) Distinguishing objects from images
5) Works under restricted conditions

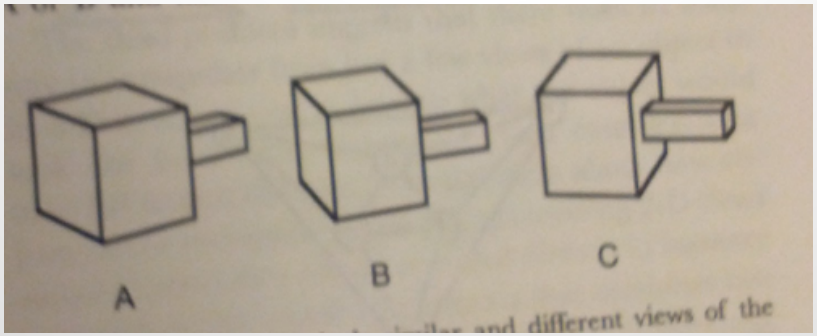
More? what do you think?

Viewpoint specific theories

2D canonical theories not sufficient

Complete 3D objects cannot be recovered from 2D representations.

Our brain needs 3D representations to navigate 2D image rotation.

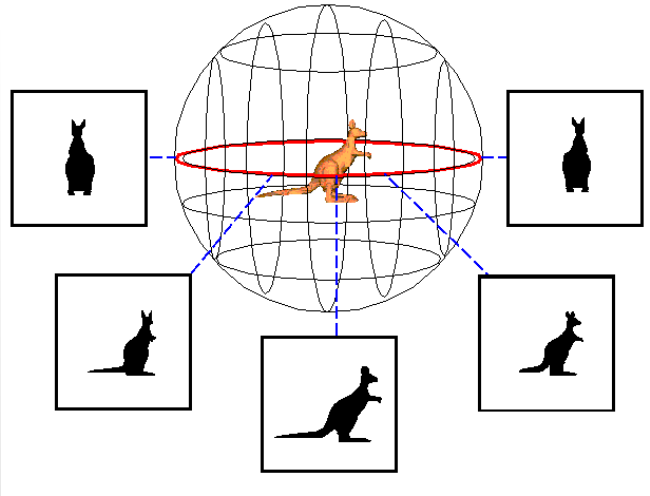


Viewpoint Specific Theories

Aspect Graphs

-View specific representations

-A network of representations containing topological 2D view



Viewpoint Specific Theories

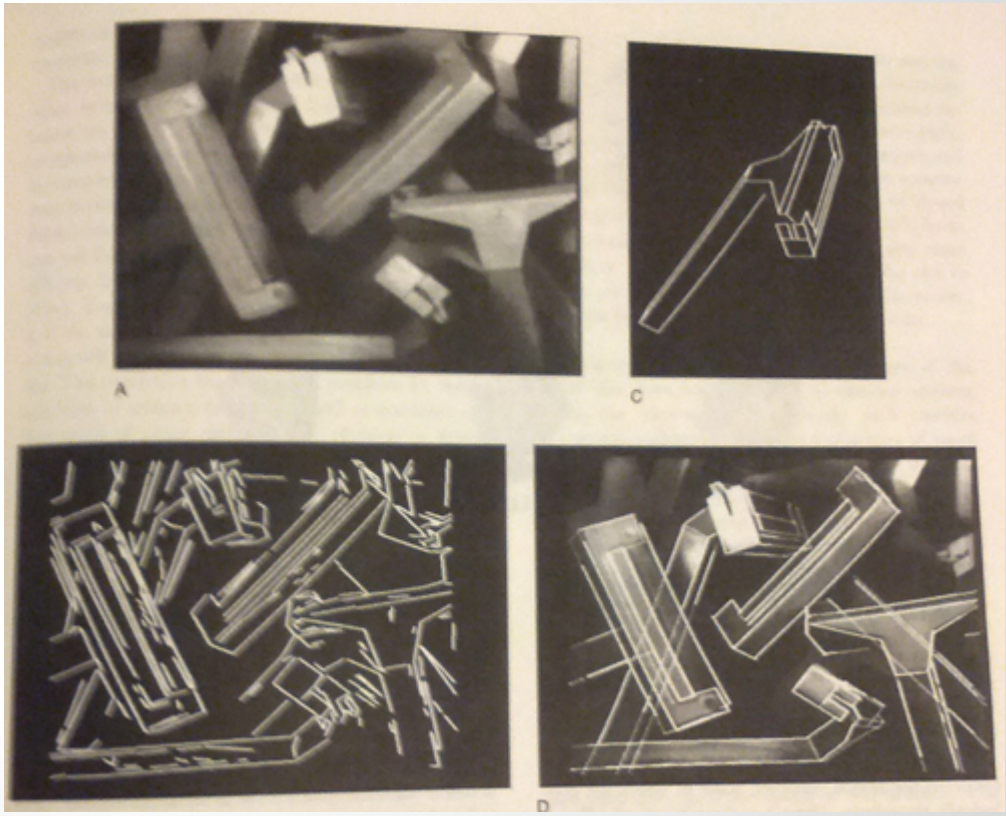
Alignment with 3D models

1) Find correspondence between image features and model features

2) Determine viewpoint that best aligns to these features of images

3) Compute projection of the full 3D model unto 2D plane from a viewpoint determined in step 2, including all points

4) Determine the degree to which this project image of 3D model matches the 2D image

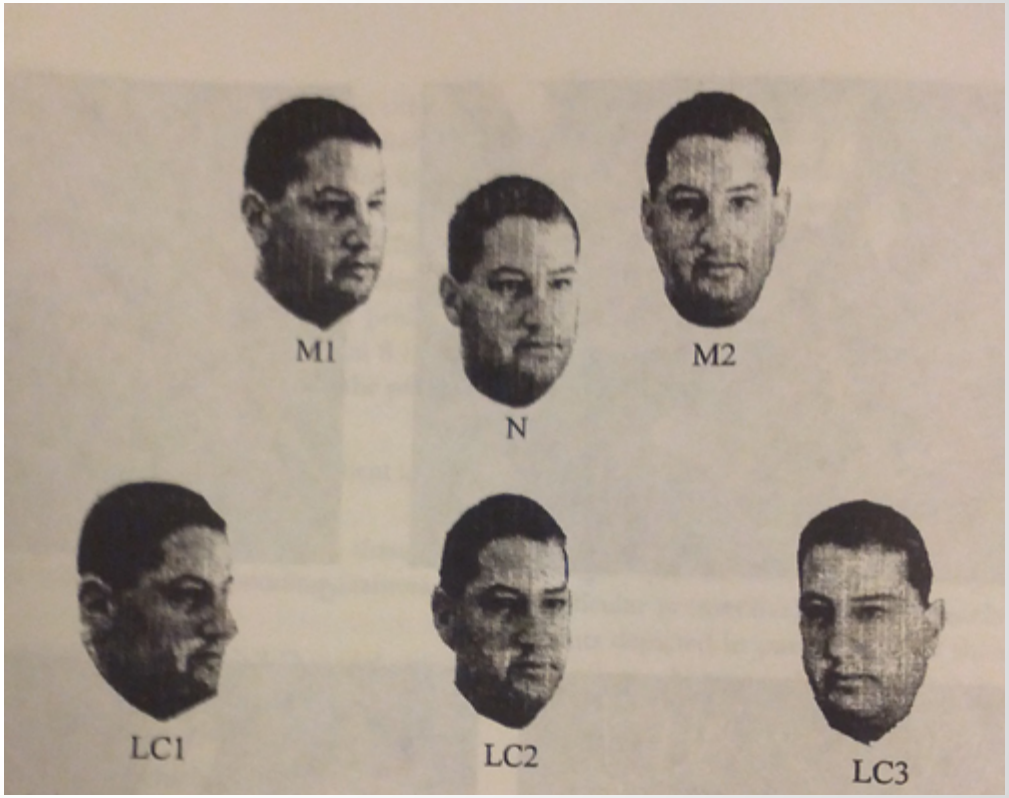


Alignment with 2D view combinations

Goal: Find method that can derive unstored 2D views of an object

+utilize a few stored 2D views

+bypass need for 3D model



Weaknesses

- 3D structures
- Novel Objects - not stored in memory
- Nonoriginal objects - accounting for lots of objects
- Part Structure - not addressed
- Exemplar Structure - more variance at entry-level

Identifying Letters with Words

Properties of text

a) 2D

-markings on flat 2D surface

-proximal stimulus for text corresponds to structure of distal stimulus

b) Combinatorial Structure

-atomic primitives

Identifying Letters

<u>Previous methods not viable</u>

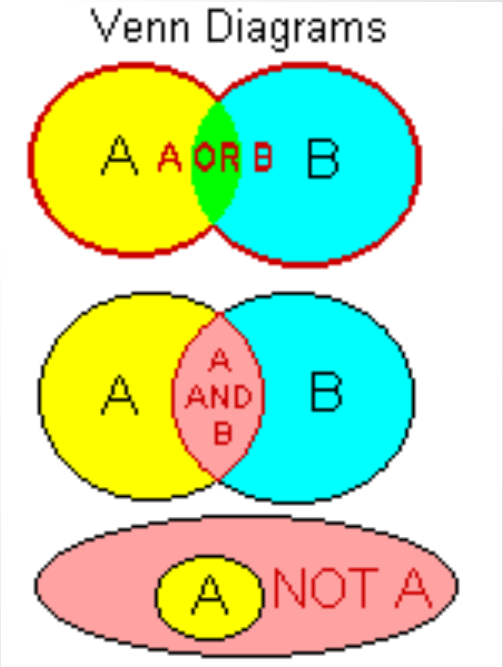
Templates

Features

Structural descriptions

Consider **FLMP - fuzzy logical multidimensional perception**

-continuous dimensional representation



Identifying Letters Within Words

Identifying letters (D, K) in

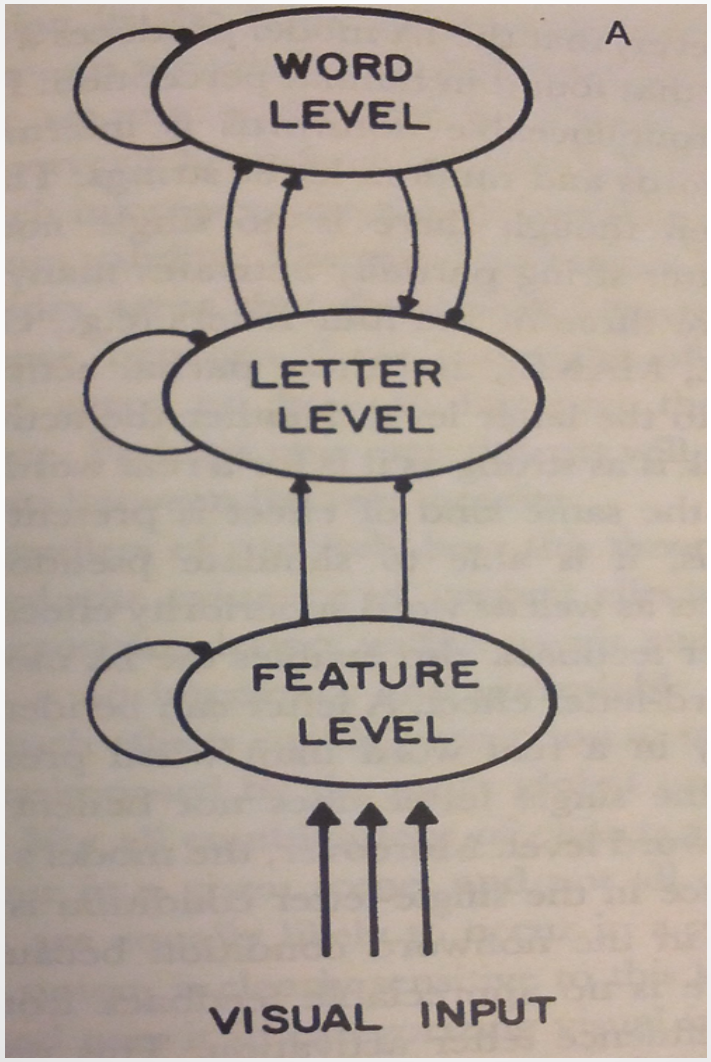
WORD

JODIF

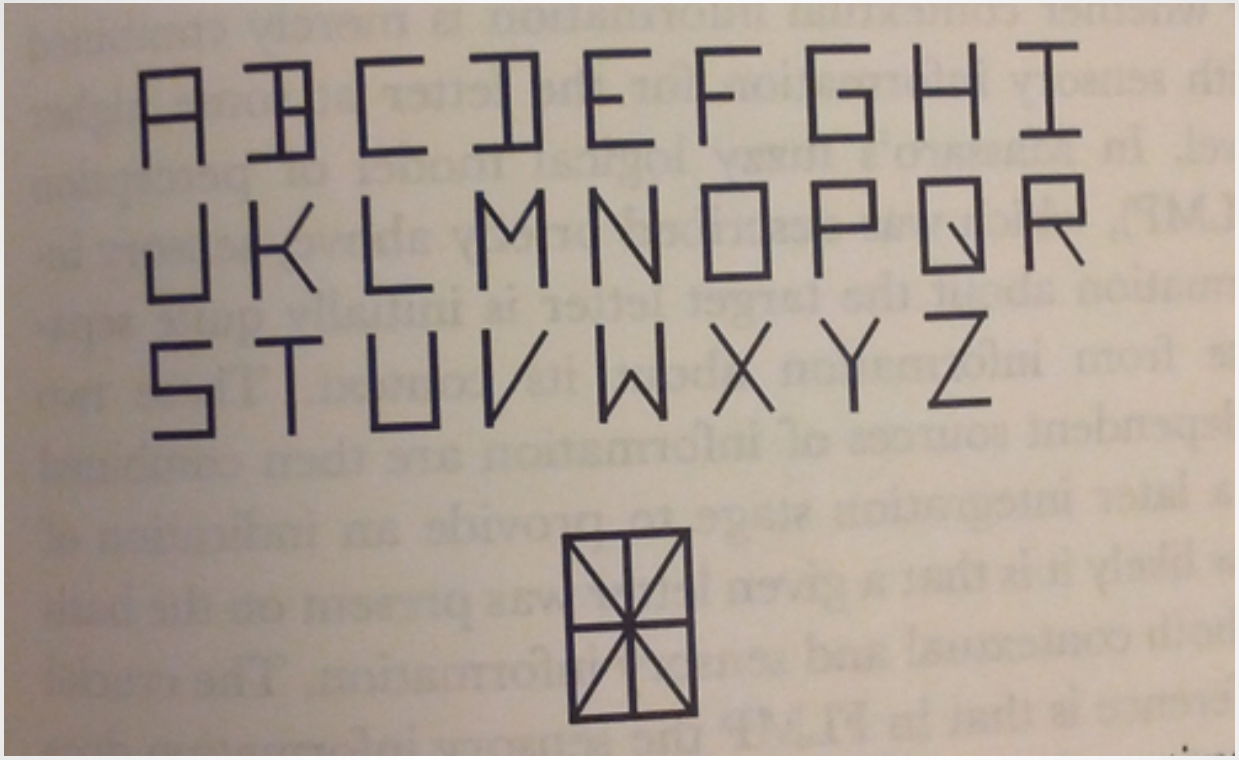
D

- **<u>Word Superiority Effect</u>**
- Word-nonword effect
- Word-letter effect
- Ever an array of letters that merely *looks* like a word helps in recognition - Redling

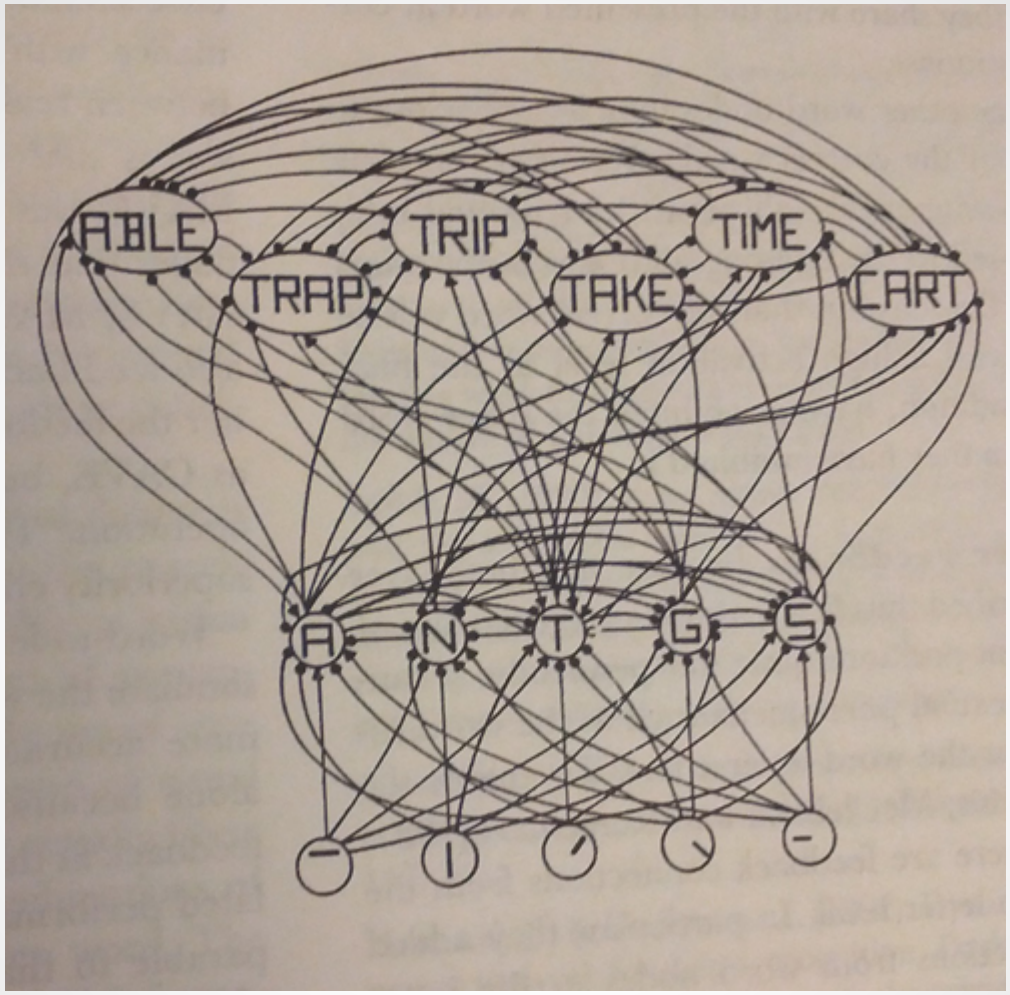
Interactive Activation model



Interactive Activation Model



If we see the top bar, we know its A, B, C etc... and it can't be X, Y, V...etc



Feedback can occur between word and letter recognition