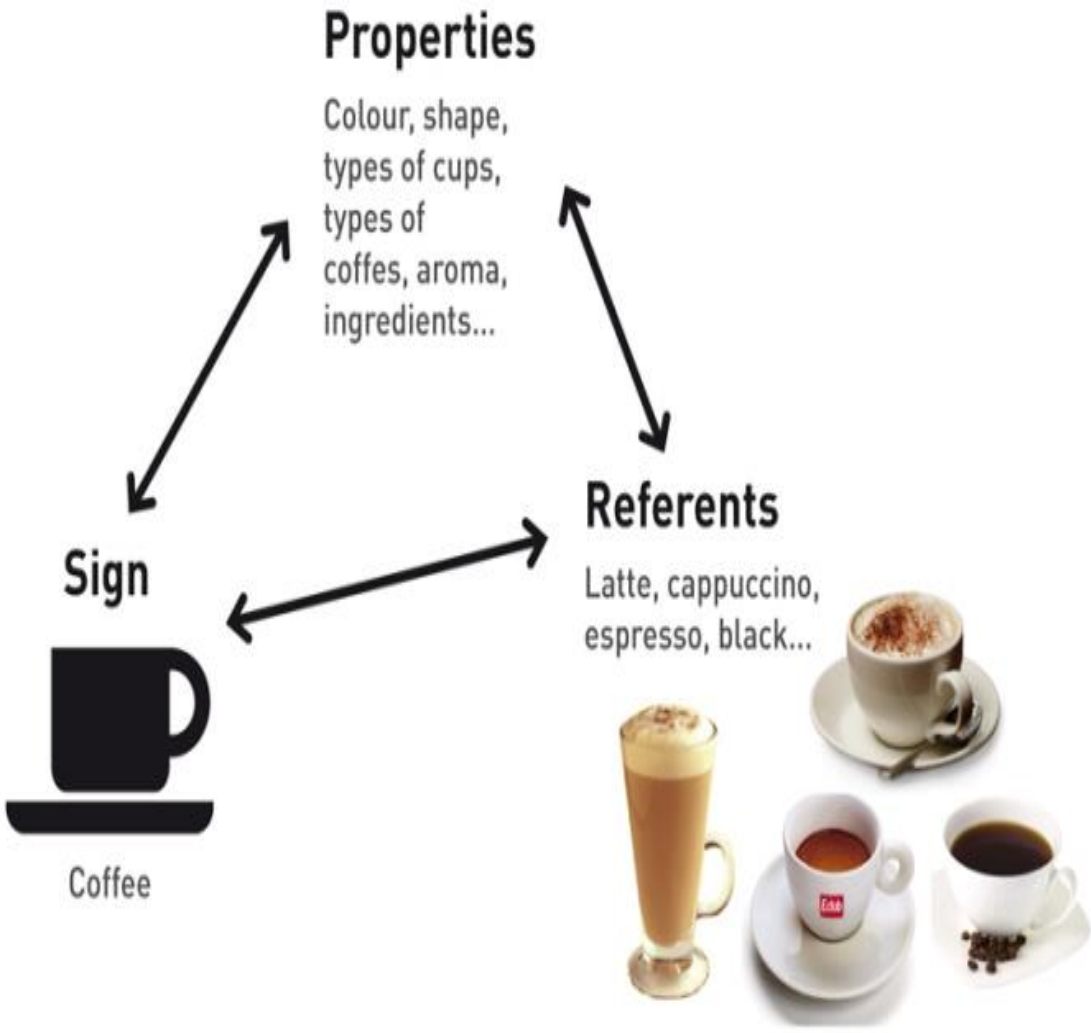
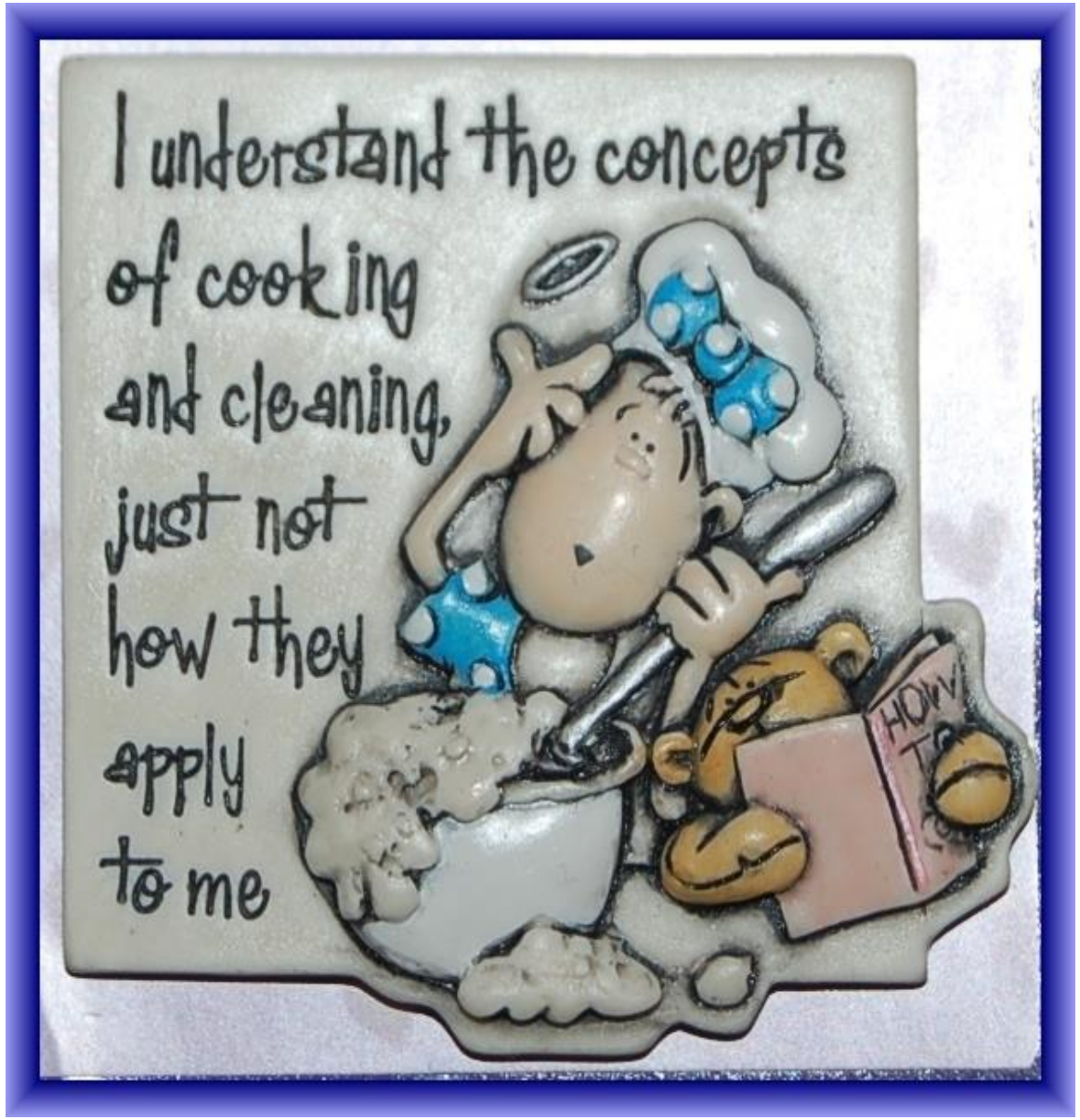
Concepts and Categories: Let me Organize....

Naveen Kashyap, PhD
Indian Institute of Technology Guwahati
Email: naveen.kashyap@iitg.ernet.in


Properties
Colour, shape, types of cups, types of coffes, aroma, ingredients...
Referents
Latte, cappuccino, espresso, black...
Sign
Coffee


I understand the concepts of cooking and cleaning, just not how they apply to me

What do humans process by cognitive processes?

In general, cognitive psychologists believe that humans ***form mental representations*** and it is these that are processed by cognitive processes. Thus all ***knowledge*** in humans are stored as ***mental representations***, and they in turn guide our behavior. Mental representation are stored ***as concepts & categories.***

What is a concept?

A concept is a ***mental representation of some object, event, or pattern*** that stores in it much of the ***knowledge*** typically thought ***relevant to that object, event or pattern***.

e.g., dog (concept) = animal, 4 legs & tail, man's best friend (knowledge)

What is a category?

A category can be defined as a ***class of similar things (objects/entities)*** that ***share one or two things***: either ***an essential core*** (e.g., why all sciences courses are considered “science”) ***or some similarity in perceptual, biological, or functional properties***

Nature of Concepts

The Classical View

It dates back to Aristotle and dominated psychology till 1970's. This view believe that ***all examples/instances of concept share fundamental characteristics/ features*.** In particular *the classical view of concepts* holds that the ***features represented are individually necessary and collectively sufficient*** (Medin, 1989).

Concept	Feature(s)
Bachelor	Male Adult Unmarried Human
Even number	Integer Divisible by 2
Triangle	Planar figure Closed geometric figure Three sided

Implications of classical view

-It assumes that ***concepts mentally represent lists of features***

- It assumes ***membership in a category is clear cut***

- It implies that ***all members within a category are created equal***

Critics of classical view

-Rosch found that ***people judge different members of a category differently***

-The idea that ***people store and refer to a list of necessary features*** when judging category membership ***is doubtful***

-Most people ***cannot generate lists of features that are individually necessary and collectively sufficient*** to specify membership in a category

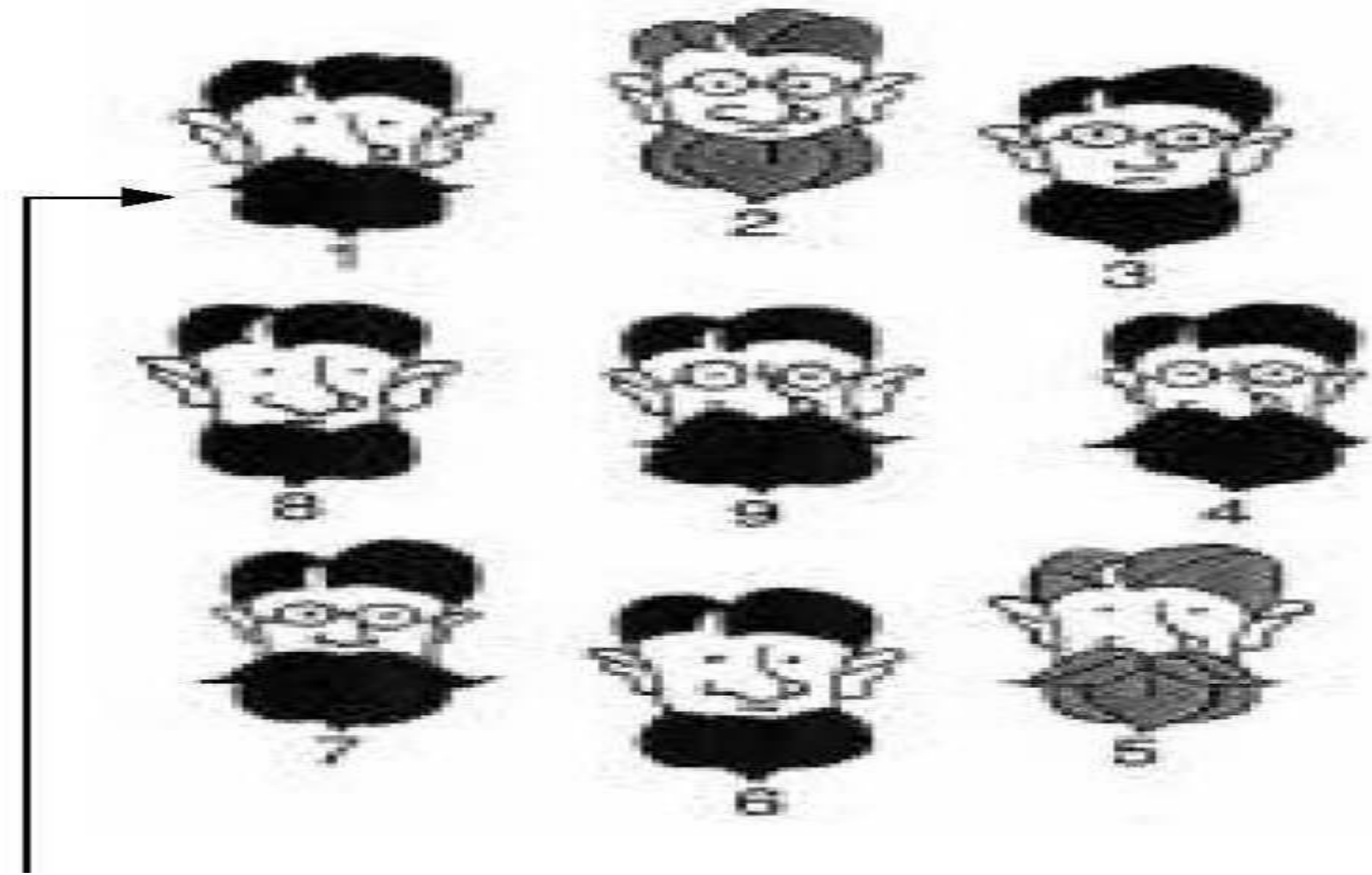
The Prototype View

Like perceptual researchers, conceptual researches believe in the existence of ***mental prototypes***, - ***idealized representations of some class of objects or events***.

Prototypes of concepts are ***features or aspects*** that are ***characteristics*** – that is typical - ***of members of the category*** rather than necessary and sufficient.

No individual feature or aspect ***need be present*** in the instance for it to ***count as a member of the category***, but the ***more characteristic features*** or aspect an instance has, the ***more likely*** it is to be regarded as a ***member of the category***.

- The prototype view of category and concepts ***refers to the family resemblance*** structure of concepts, ***a structure*** in which ***each member*** has a ***number of features***, ***sharing different features with different members.***


1
2
3
8
9
4
7
6
5

-A prototype is some sort of ***abstraction that include all the characteristics of a category*** and ***may/may not be actual instance of category***. Prototypes are often thought of as ***mental "summaries" or "averages"*** of all the instances.

-Concepts exists at many ***different level of a hierarchy*** but one level of abstraction appears ***psychologically fundamental***. This is the ***"basic level" and different from both higher level (super-ordinate) and lower level (sub-ordinate) concepts.***

Critics of Prototype View

-It fails to capture people's knowledge about the ***limits of conceptual boundaries.***

- A second problem from the prototype view has to do with ***typicality ratings***

The Exemplar View

concepts include ***representations of at least some actual individual instances***

categorize new instances by ***comparing to representations*** of previously stored instances, called ***exemplars****.*

difficulty categorizing unclear, atypical instances because such instances are ***similar to exemplars of different categories***

Critics of Exemplar View

- like prototype view it is ***too unconstrained*** and fails to specify ***which instances will eventually be stored*** as exemplars

- how ***different exemplars are "called to mind"*** at the time of categorization.

THE NINE TAXONOMIES USED AS STIMULI

Superordinate	Basic level	Subordinates	
		Nonbiological taxonomies	
Musical instrument	Guitar	Folk guitar	Classical guitar
	Piano	Grand piano	Upright piano
	Drum	Kettle drum	Base drum
Fruit[a]	Apple	Delicious apple	Mackintosh apple
	Peach	Freestone peach	Cling peach
	Grapes	Concord grapes	Green seedless grapes
Tool	Hammer	Ball-peen hammer	Claw hammer
	Saw	Hack hand saw	Cross-cutting hand saw
	Screwdriver	Phillips screwdriver	Regular screwdriver
Clothing	Pants	Levis	Double knit pants
	Socks	Knee socks	Ankle socks
	Shirt	Dress shirt	Knit shirt
Furniture	Table	Kitchen table	Dining room table
	Lamp	Floor lamp	Desk lamp
	Chair	Kitchen chair	Living room chair
Vehicle	Car	Sports car	Four door sedan car
	Bus	City bus	Cross country bus
	Truck	Pick up truck	Tractor-trailer truck
		Biological taxonomies	
Tree	Maple	Silver maple	Sugar maple
	Birch	River birch	White birch
	Oak	White oak	Red oak
Fish	Bass	Sea bass	Striped bass
	Trout	Rainbow trout	Steelhead trout
	Salmon	Blueback salmon	Chinook salmon
Bird	Cardinal	Easter cardinal	Grey tailed cardinal
	Eagle	Bald eagle	Golden eagle
	Sparrow	Song sparrow	Field sparrow

[a] Fruit is not considered a biological taxonomy by the criteria in Berlin (1972).

or greater from the Kučera and Francis (1967) sample of written English. A superordinate category was considered in common use if at least four of its members met this criterion. Categories were eliminated if: (a) all of the items bore a part–whole relationship to the only reasonable superordinate (e.g., parts of the body, parts of buildings), (b) if there was linguistic ambiguity amongst possible superordinates (e.g., *animal* is commonly used as a synonym for *mammal*), and (c) if the superordinate cross-cut a large number of other taxonomic structures (e.g., *food*).

By these criteria, only one biological category, *bird*, could be included in the study. Because biological taxonomies were the only ones in which hypotheses concerning basic objects based on independent linguistic evolutionary data existed, it was necessary to amend the inclusion criteria. A biological category was included if at least one member of the category (or the superordinate noun itself) achieved a Kučera and Francis frequency

The Schemata View

This view ***shares features with both the prototype view*** (in that both schemata and prototypes store information that is abstracted across instances) ***and the exemplar view*** (both schemata and exemplar store information about actual instances).

Critics of schemata view

-It does not ***specify clear enough boundaries*** among individual schemata

- The schemata framework, in the present view, ***is not sufficiently delineated*** to be ***empirically testable***

- Also question like ***what information leads to schemata*** and ***how are they modified*** plus the ***process of using appropriate schemata*** is not known.

The Knowledge Based View

The idea of knowledge-based view is that a person classifying objects and events ***doesn't just compare features or physical aspects*** of the objects and events ***to features or aspects of stored representations***. Instead, the person ***uses his/her knowledge of how the concept is organized, to justify the classification*** and to explain why certain instances happen to go together in the same category.

Most previous views of concepts ***fail to answer satisfactorily how things in the same category go together***. The knowledge based view proposed that ***people's theories or mental explanations about the world are intertwined with their concepts and provide the basis for categorization***

The Five approaches to conceptual structure has been categorized into two subtypes (Komatsu, 1992).

Similarity based category

- The *similarity based* category consists of classical, prototype, exemplar & parts of schemata views.

- It includes approaches in which categorization is assumed to be based on the similarity of an instance to some abstract specification of the category

- The key critic of this view is that similarity is meaningful only in certain respects

***Explanation based* category**

- Comprises of the schemata view and knowledge based view.

- People using this view base classification on meaningful relationships among instances and categories.

Forming New Concepts and Classifying New Instances

Concept formation requires some basis of generalization, for grouping certain things but not others together. This process requires figuring out what features are relevant / irrelevant with little feedback.

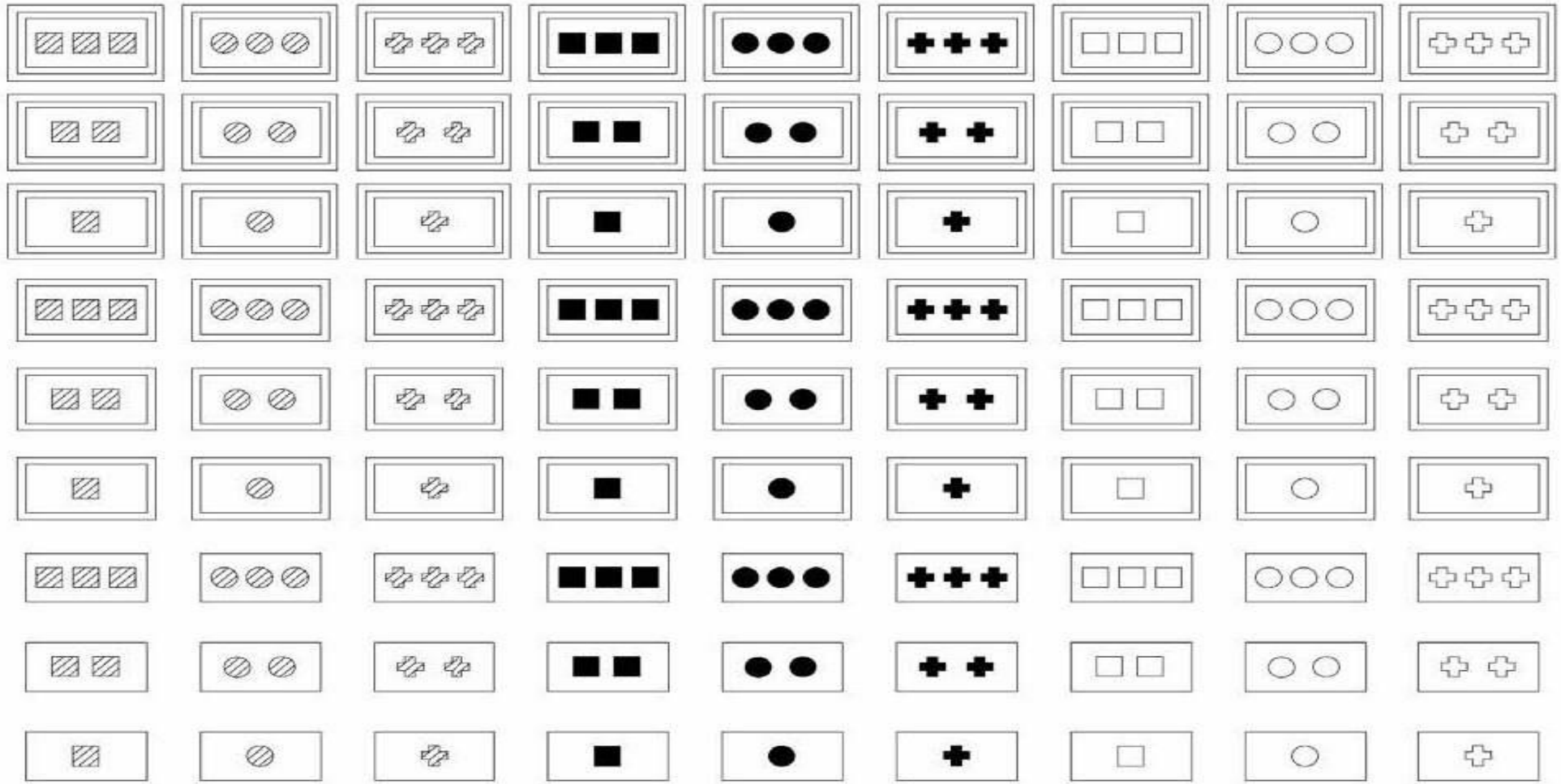
Concept Attainment Strategies

The process of acquiring concepts involve – *acquiring the information* necessary to isolate and learn a concept, *retaining the information* for later use and *transforming the information* to make it usable when testing ideas about new possible instances. The possible strategies for concept formation involve

- *Simultaneous Scanning*

- *Successive Scanning*

- *Conservative Focusing*



Bruner et.al. (1956) found that the effectiveness of each of their strategies depend to some extent on the task conditions

Acquiring Prototypes

- People do form and use prototypes, even when given distorted instances during the learning

- Learning about category variability may be at-least as important as learning about prototypes, especially if categorizations are to be made later for new instances that vary a great deal from the prototype

Implicit Concept Learning

Brooks (1978) defined *Non analytical concept formation (in contrast to logical, scientific and focused),* also called *Implicit Learning*, require that people pay attention to individual exemplars, storing information about the representations of them in memory. Later classifications are done by comparing new instances to the representations, drawing analogies between new and old.

Brooks describes five factors that encourage people to store information about individual exemplars

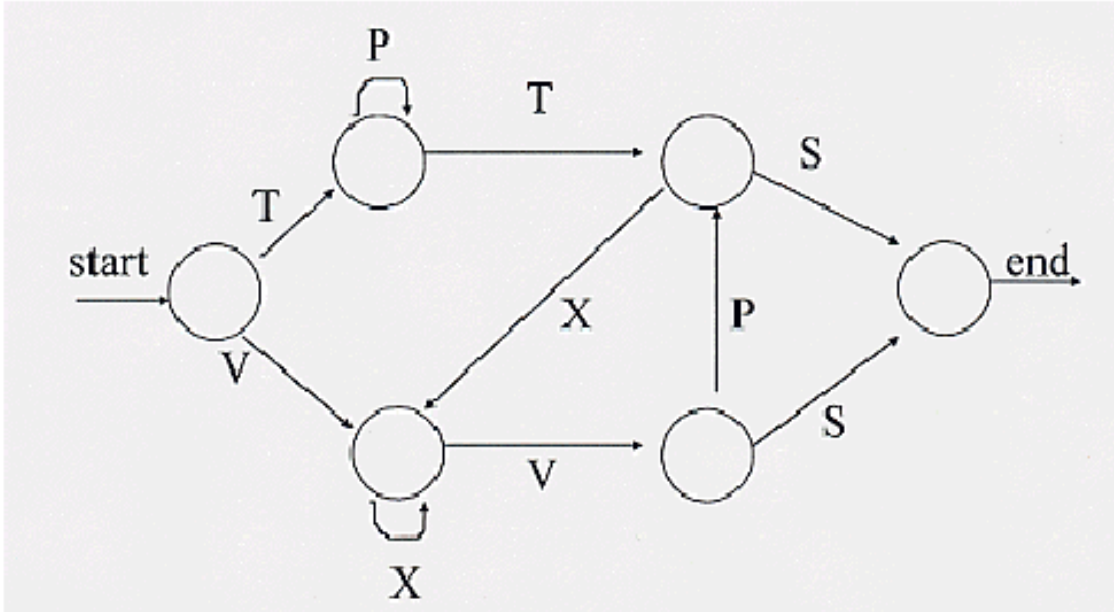


Figure 1: The finite-state artificial grammar created by Reber (1967)

- Examples of ruleful & unruleful strings:

VXVS	VXXXS
TPTXVS	TPTPS

Training list

Stimuli	Responses
	worm
	gun
	tiger
	bus
	bee
	kite
	stork
	bomber

(A)

Test list

Stimuli	Concepts
	flies-doesn't
	
	big-small
	
	live-not
	
	attacks-peaceful
	

(C)

Stimulus Semantic Correspondences

flies	big	live	attacks
			
doesn't	small	not	peaceful
			

- The first factor involves task requirements to learn information that distinguishes among individual instances

- A second factor involves the original learning situation

- Third, some stimuli lend themselves to hypothesis testing better than others

- A fourth factor is that in real-life concept learning, instances may belong to a number of categories all at the same time.

- Fifth, in natural settings we learn about instances without knowing how we will be called on to use the information later.