Perception: Making Meaning of Sensations

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

Introduction to Cognitive Psychology
Dept. Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

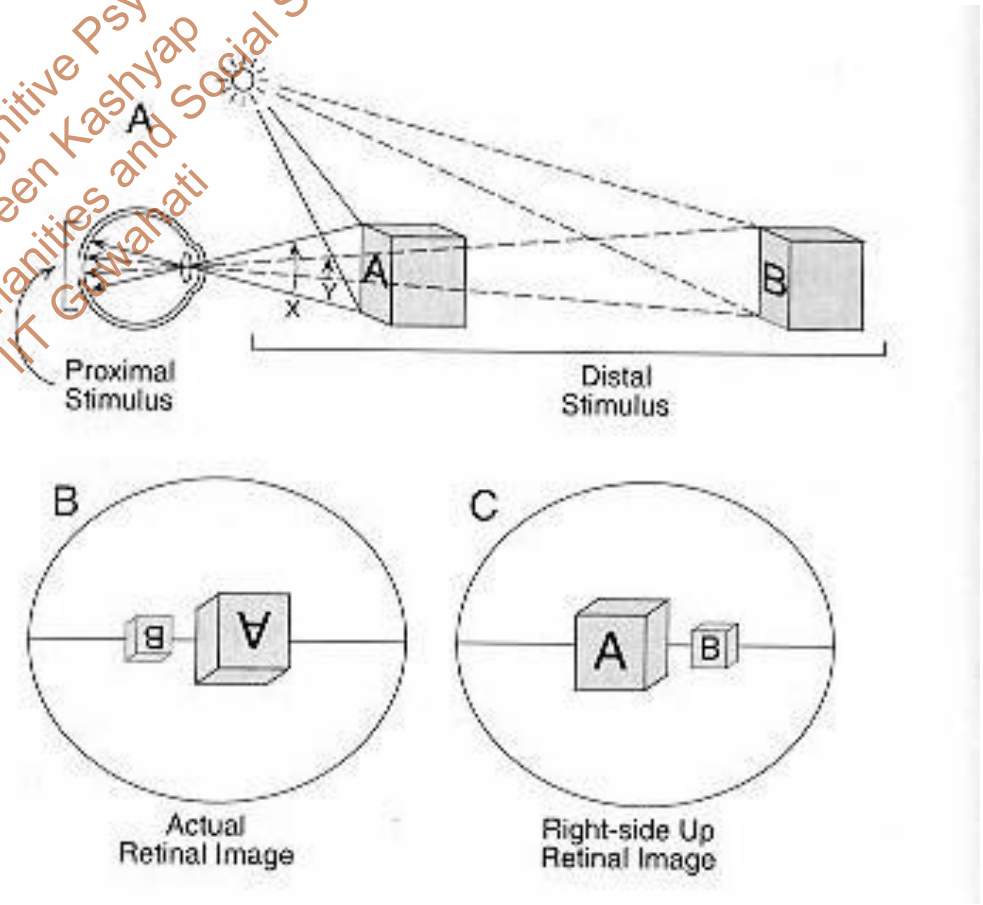
Object Perception and Pattern Recognition

The process via which sensory inputs are gathered and meaningfully interpreted is called perception. There are several forms of perception. When we look at an object we acquire specific bits of information about it (location, kolor, shape, texture etc).

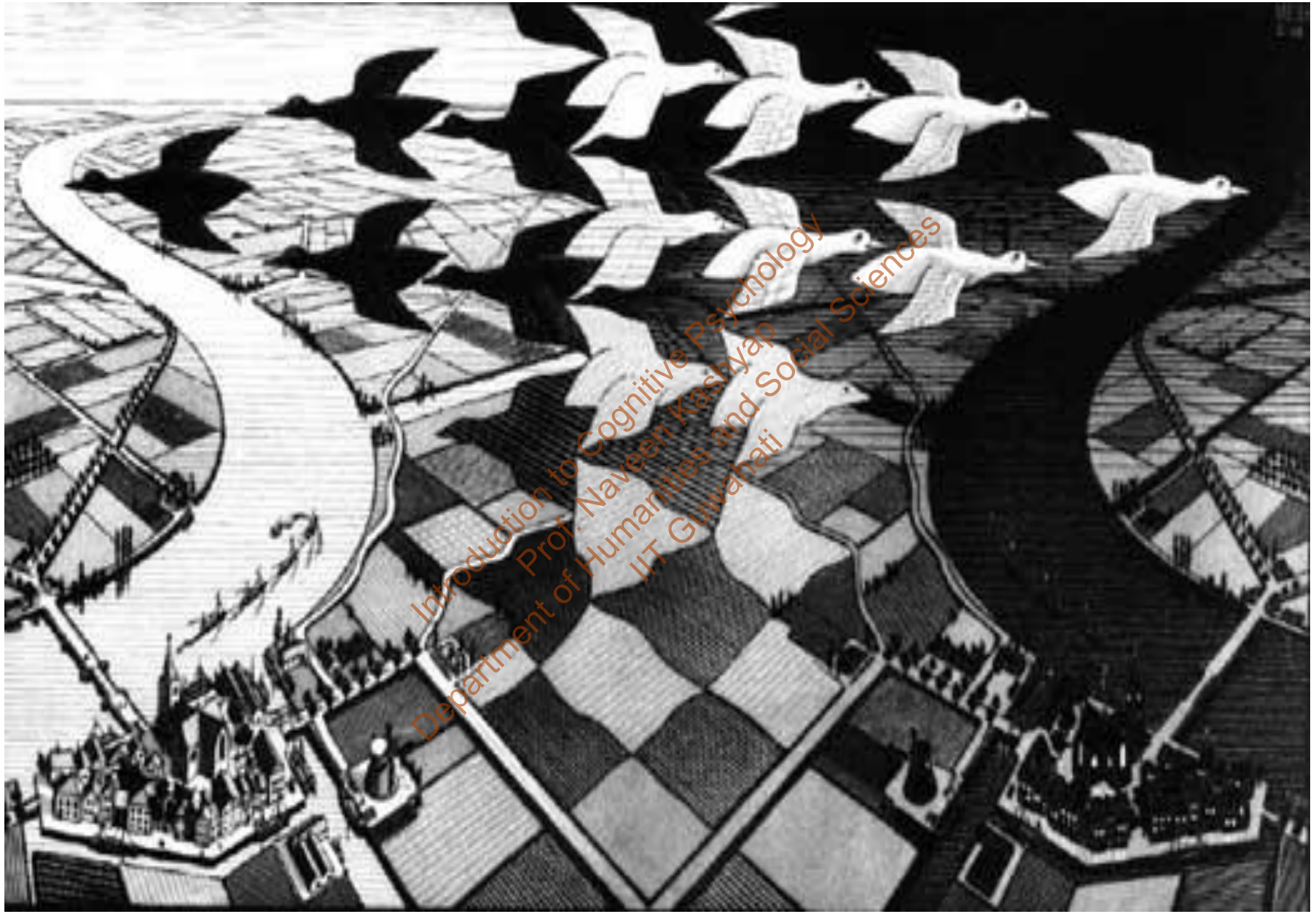
Is it true that we also at the same time when we perceive an object we also acquire information about its function?

Classical approach to perception

Each of the objects/events in the real world like trees, books etc are ***distal stimulus***. The reception and registration of information about such o/e by sense organs make up the ***proximal stimulus*****.** The meaningful interpretation of the proximal stimulus is the ***percept.*** Related to the process of perception is a process called ***pattern recognition*** – which is the recognition of a particular o/e as belonging to a class of o/e.



Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

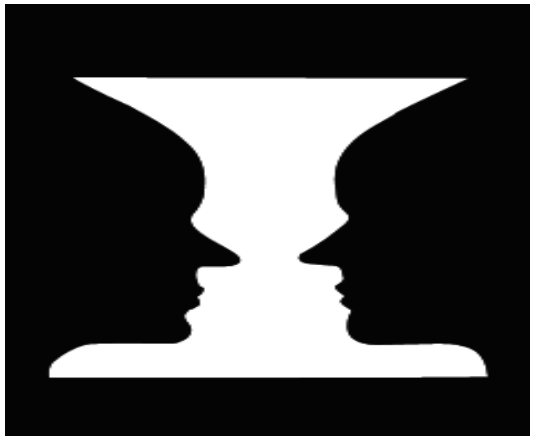


Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati


Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Gestalt Approach to Perception

Gestalt approach interprets visual perception as how interpretation of stimulus arrays are done as ***objects*** and ***backgrounds***. For example the figure show two



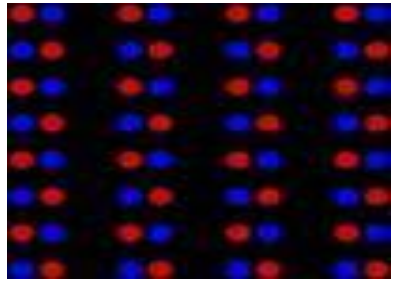
distinct percepts: a white vase against a black background / two silhouetted faces against a white background. This whole segregation of the whole display into objects (figure) and the background (ground) is called ***form perception***. The part of the display seen as figure is seen to have a definite shape and is better remembered than the ground which is less formed and shapeless. Form perception happens as we assume intuitively that we perceive objects and ground because they really are so and we merely perceive them

The gestalt psychologists believed that perceivers follows certain laws or principles of organization in coming to their interpretations The first assumed that ***the whole (gestalt) is not the sum of its part.***

Introduction to Cognitive Psychology
Prof. Nazeen Kaabyap
Department of Humanities and Social Sciences
IIT Guwahati

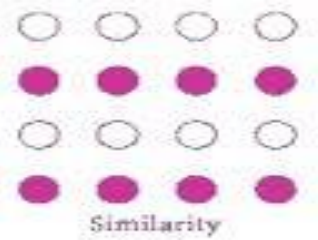
Gestalt principles of perceptual organization – there are five major principles

a) *Principle of proximity or nearness – this principle allows us to group together things that are nearer to each other.*



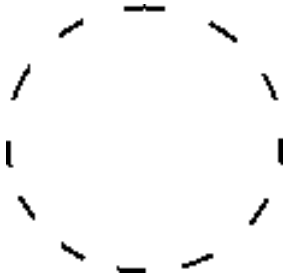


b) ***Principle of similarity*** *– allows us to group together objects that are similar*

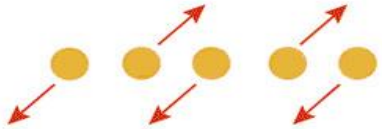




c) ***Principle of good continuation*** *– states that we group together objects whose contours form a continuous straight or curved line*



d) ***principle of closure*** *– allows us to see images as complete by mentally filling the gaps in the image*



e) *Principle of common fate – allows us to depict elements that move together to be grouped together*

Law of Pragnanz (Koffka, 1935) *– is a general principle of gestalt that houses all the other principle. It states that of all the possible ways of interpreting a display, the organization that yields the most simplest and stable shape or form is the one that is selected to interpret the element in question.*



Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Limitations of Gestalt approach

a) *There is no explanation how these principles are translated into cognitive/physiological processes*

b) The law of pragnanz seems to be circular (if additional specification is not given)

Bottom-Up Processes of Perception

The term bottom up (data driven) essentially means the perceiver starts with small bits of information from the environment that he combines in various ways to form a percept.

example: a bottom up process of perception and pattern recognition might describe you seeing edges, rectangular and other shapes and certain lighted regions and putting this information together to "conclude" you are seeing doors and a hallway.



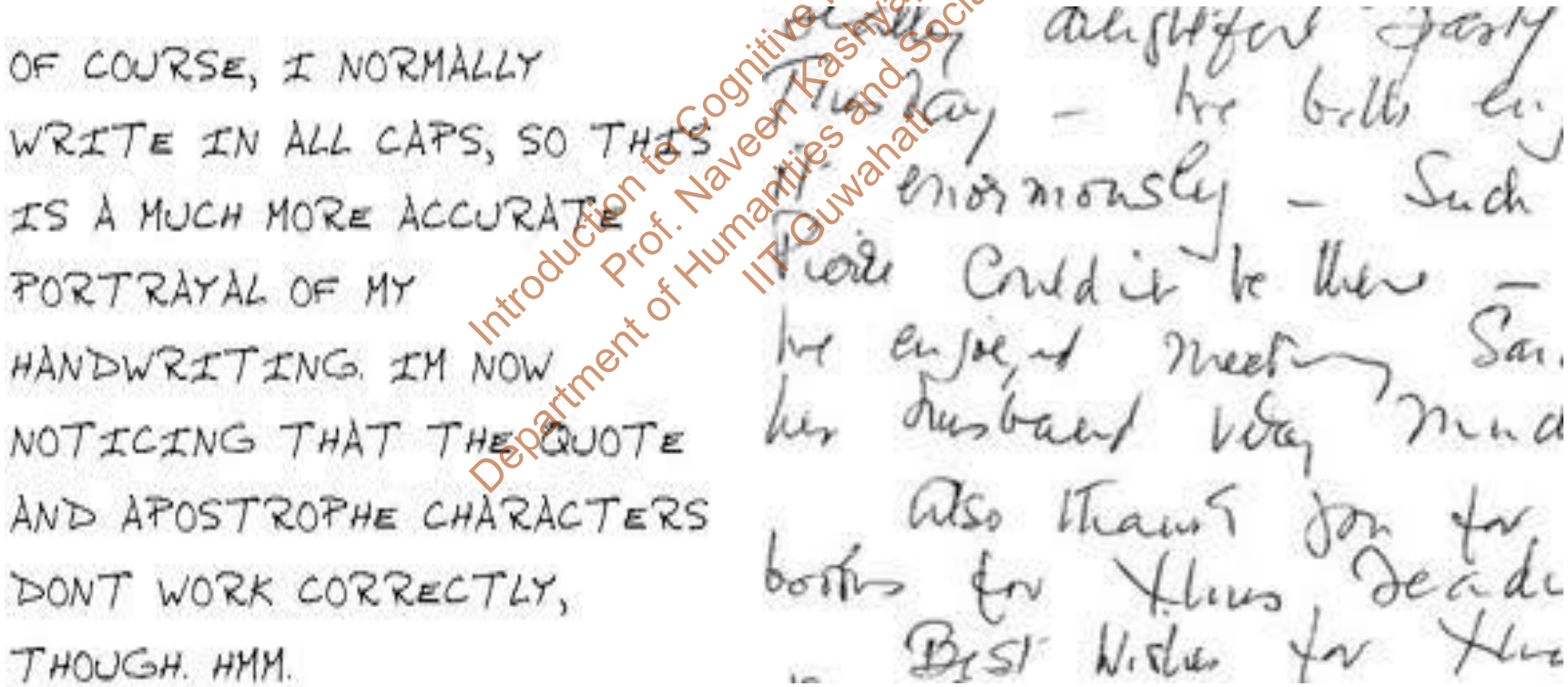
Picture = depth + figure + ground + texture + semicircular arch + semi circular block (door) like + ..

Template Matching – Every event, object or stimulus that we want to derive meaning from is compared to some previously stored pattern or template. The process of perception in *template matching* thus involves comparing incoming information to the templates we have stored and looking for a match.

Limitations: a) requires a huge database to compare from

b) recognition of new objects

c) people recognize many patterns as more as less same thing



Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Featural Analysis – Instead of processing stimuli as whole units, we might instead break them down into their components, using our recognition of those parts to infer what the whole represents. The parts searched for and recognized are called *features.* Recognition of a whole object in this model depends on recognition of its features.

Support for FA model: Studies done on retinas of frogs using microelectrode recording of single cell revealed that certain stimulus caused these cells to fire more rapidly then certain others. Certain cells responded strongly to *borders between light and dark* were called *edge detectors,* while certain other cells responded *selectively to moving edges* were called *bug detectors.*

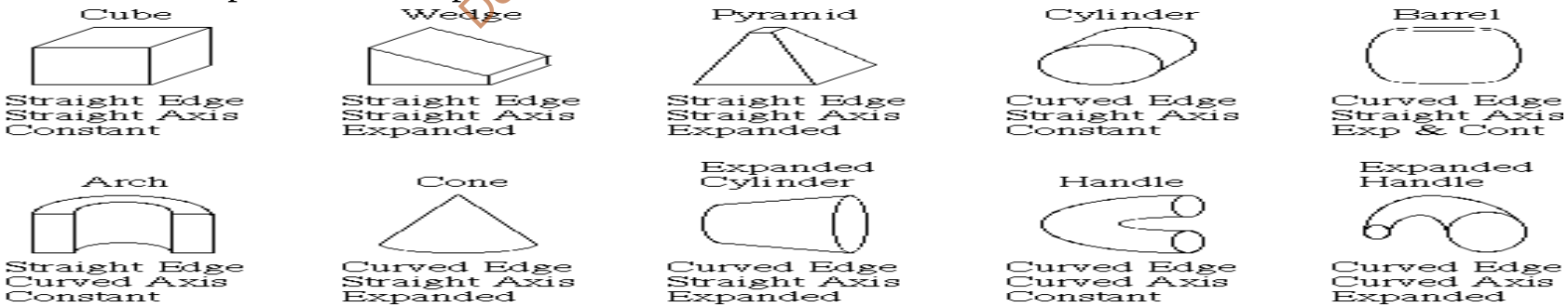






Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Irving Biederman's (1987) theory of object perception – proposes that when people view objects they segment them into simple geometric components like *geons.* Biederman proposed a total of 36 such primitive components.



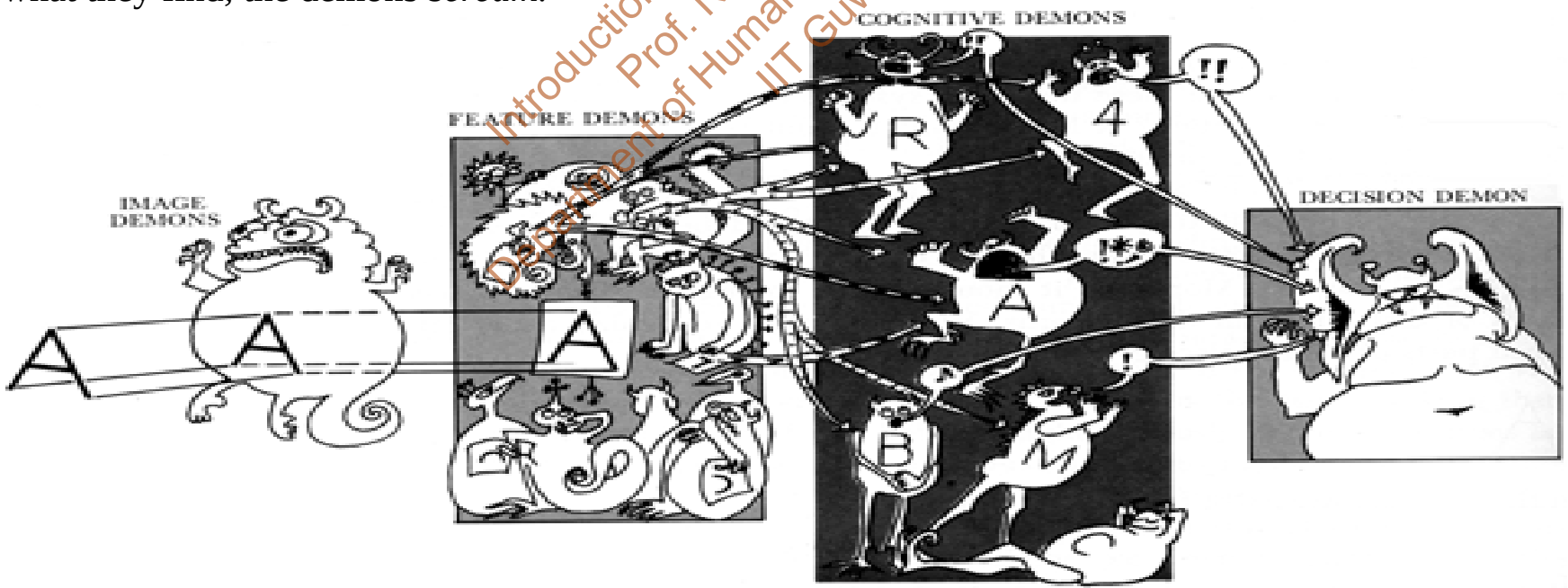
Biederman makes an analogy between his theory of object perception with speech perception using *phonemes* (which are 44 in number and are the basic unit of sound like /tS/ as in *ch*air). As an evidence to this theory Biederman offers the case of any fictional object that non of us has seen but can try to decipher its parts with considerable agreement

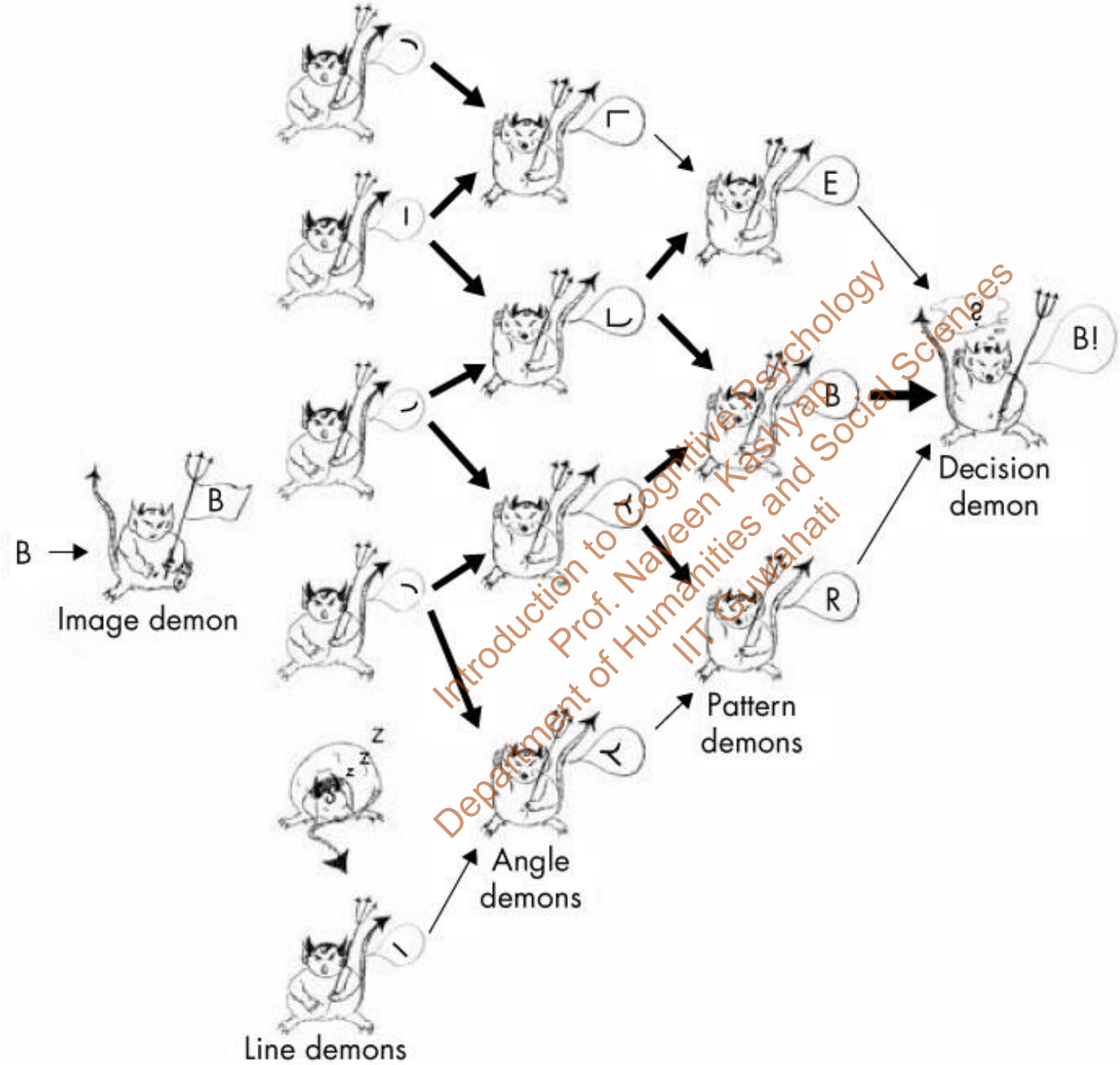


Support for the featural theory also comes from the works of Eleanor Gibson (1969) which proved that people are more likely to confuse with G & C then with G & F as G & C share the same features of curved line open to the right.

Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Sefridge (1959) – *Pandemonium model* – consists of number of different kind of *"demons"* which function basically as feature detectors. *Demons* at the bottom level (first) of processing scan the input and *demons* at higher levels scan the output from the lower level *demons*. In response to what they find, the demons *scream.*





Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Limitations of FAM – FAM suffers from the following shortcomings

a) There is no good definition of what can and cannot be a feature except the restricted domain of perception of letter / line drawings

b) If there are different sets of features for different objects, how does the perceiver know which ones to use to perceive an object

Prototype Matching – explains perception in terms of matching an input to a stored representation of information as do template models. In this case, however the stored representations , instead of being a whole pattern that must be matched exactly or closely, is rather a *prototype* – an idealized representation of some class of objects or events – the letter *M*, a cup, a CAR etc.









Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

According to prototype matching model – when a sensory device registers a new stimulus, the device compares it with previously stored prototypes. An exact match is not required, only an approximate match is expected. Prototype matching models allows for discrepancies between the input and the prototype. An object is *perceived* when a match is found

Where do prototypes come from?

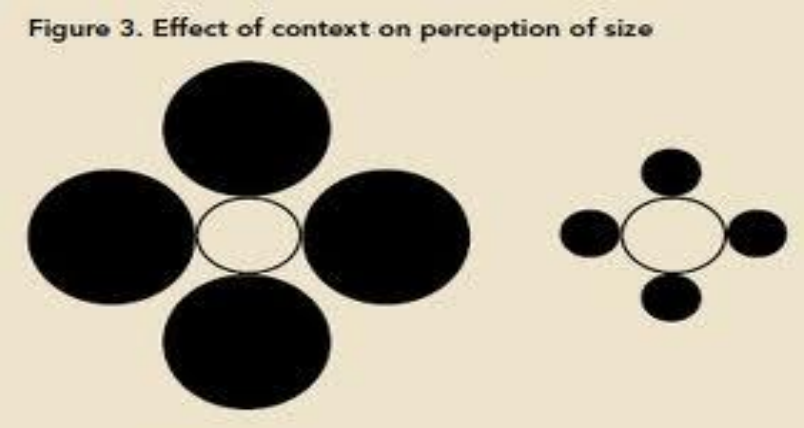
Posner & Keele (1968) demonstrated that people can form prototype very quick. They found that people during an initial classification task, from some sort of mental representation of each class of items.

Top-Down Processes

*In **top-down processing** (also called **theory-driven** or **conceptually driven** processing) the perceivers expectation, theories or concepts guide the selection and combination of the information in the pattern recognition process. (for example)*



You know from experience that archways generally mark alleys. When you look down the alley and see it blocked in black you mostly expect a closed door etc…….





The context in which patterns or objects appear apparently sets up certain expectations in the perceiver as to what objects will occur. Both accuracy and the length of time needed to recognize an object vary with the context.

Top-down or conceptually driven processes are directed by expectations derived from context or past learning or both.

David Marr – presented a computational and most elegant model of perception which involves both the bottom up and top down process. According to this model visual perception proceeds by constructing three different mental representations

a) ***primal sketch*** *– depicts areas of relative brightness and darkness in a 2D images as well as localized geometric structures. This helps in* ***boundary detection***

b) ***2 ½ D sketch –*** *using cues such as shading, texture edges and others the viewer derives* ***what the surfaces are*** *and how they are positioned in* ***depth*** *relative to the viewers vantage point*

c) ***Final 3D sketch –*** *involves both recognition of what the objects are and understand the meaning of the visual scene*

Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Perceptual Learning – perception changes with practice has been well documented (E. J. Gibson, 1969), and this phenomenon is called ***perceptual learning.*** (Gibson's original experiment with round coil cards). Making individuals practice more with perceptual stimuli's enable them to learn what aspects of the stimulus to attend to and try harder to consciously distinguish between different kinds of stimuli. Using top-down processing the perceivers experience guides him in selecting the most optimal features to for more information



Change Blindness -

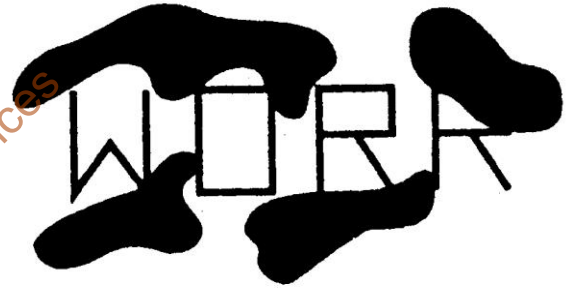




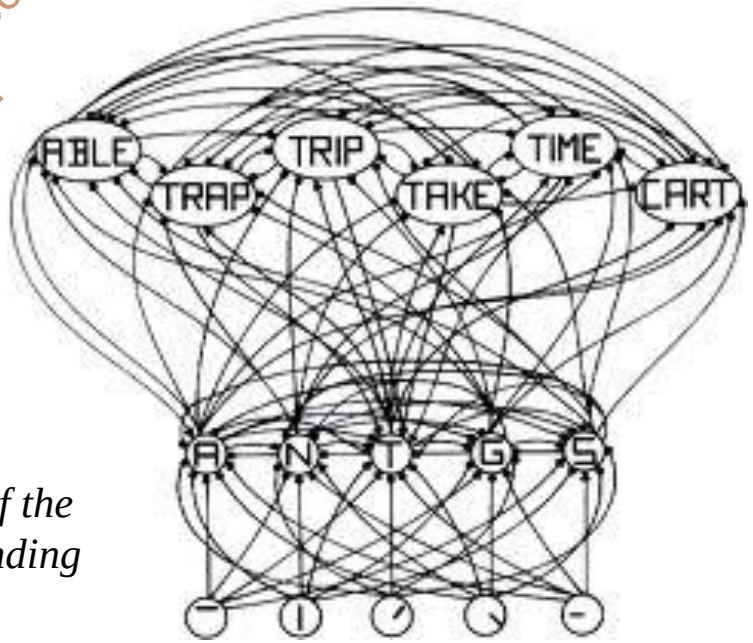
Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Change blindness *– (Rensink, 2002) is the inability to detect changes to an object or scene, especially when given different views of that object or scene and it illustrates the top-down nature of perception. The change blindness paradigm reinforces the idea that perception is driven by expectations about meaning. Instead of keeping track of every visual detail we instead seem to represent the overall meaning of the scene.*

The word superiority effect *– word superiority effect or word advantage advances that letters are apparently easier to perceive in familiar context (a word) then in an unfamiliar or no context environment.*



Connectionist model of word perception *– the model assumes that input (written, spoken, thought) is processed at several different levels, whether in terms of features, letters, phonemes or words. Different levels of processing feed into one another, with each level of processing forming a representation of the information at a different level of abstraction., with features considered less abstract then letters and letters less abstract then words.*



According to this model *– perception of a word (activation of the relevant node for the word) also activates the nodes corresponding to all the letters within the word thereby facilitating their perception*

Introduction to Cognitive Psychology
From: Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

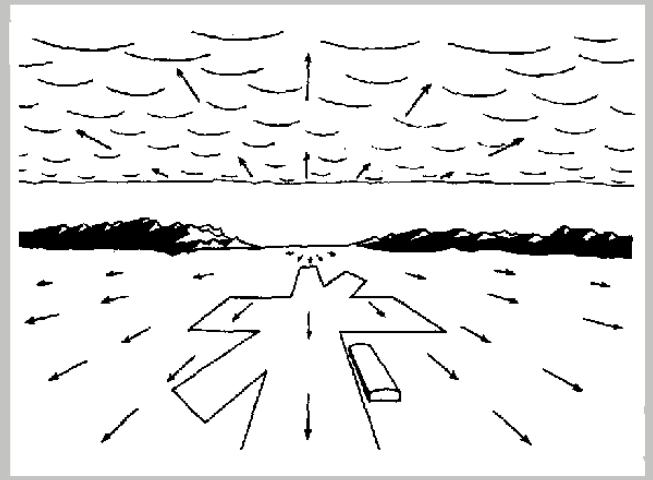
Direct Perception

Top-down and bottom down processes of perception believe that the perceiver does something to the proximal stimulus for perception to proceed. This happens presumably because the proximal stimulus doesn't contain all the information we need to identify the object. This idea is called the ***constructivist approach to perception.*** *It describes people as adding to and distorting the information in the proximal stimulus to obtain a percept.*

James Gibson (1979) et.al., adopted an opposite view to the connectionist approach and believed the perceiver does very little work in perception mainly because the word offers so much information leaving little need to construction percepts and draw inferences. This view is called ***Direct Perception***. *According to this view the light hitting the retina contains highly organized information that requires little or no interpretation. In the world that we live in, certain aspects of stimuli remain invariant despite changes over time or in our physical relationship to them.*

Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Gibson became convinced that patterns of motion provide a great deal of information to the perceiver. His work with pilots in WWII led him to develop the idea of *optic flow* as the visual array presented to a pilot approaching the runway for landing. The arrows represent perceived movement (apparent motion of clouds, grounds etc wrt the pilot). There is a texture in the motion namely nearer things appear to move faster and direction in which objects seem to move depends on the angel of plane motion in relation to them. These information are used by the pilot to land the plane



idealised flowfield (after Gibson, 1950)

For Gibson the central question of perception is not how we look at and interpret the stimulus array but how we see and navigate among real things in the world. An important ideal of Gibson's theory is that information available to an organism exists not merely in the environment but in an animal-environment ecosystem.

Organisms directly perceive not only shape and whole objects but also each objects ***affordance's – the acts or behaviors permitted by objects, places and events*** *(e.g. chair affords sitting, door knob affords grasping, a glass window – looking etc)*

Introduction to Cognitive Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati