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Lesson 01

INTRODUCTION

Cognitive Psychology deals with cognition. Cognition can be understood as "thinking" or "knowing." We can say, in other words, that cognitive psychology deals with the processes involved in thinking, acquisition and storage of knowledge. For this purpose it adopts an information processing approach.

Historical Background

Plato, the great Greek philosopher, was the first person to present a coherent theory of how knowledge is acquired and retained. He proposed that ideas are created in the human mind and that these ideas are then projected out in the world. These projections serve as images that we see through our senses. In other words, the outside world is an illusion made up of projections of ideas and the true reality lies inside of us. Therefore, Plato concluded that perception is an internal process and we can learn everything by looking inwards.

When psychology was first taught in European universities, it was subsumed under the title of mental philosophy. Philosophers throughout the history have been concerned with concepts of perception and knowledge, as to how these interact with reality. Similarly the field of epistemology within philosophy has been concerned with the nature of knowledge. Thus cognitive psychology has been present as an undercurrent in the field of ontology and epistemology throughout the last two millennia.

More recently, in 1875 Wilhelm Wundt set up the first psychological laboratory to study perception and cognition. A lot of the perceptual experiments and studies conducted were included in the field he called psychophysics. An example of psychophysics is the relationship of sensation and intensity of the stimulus.

A major problem with most psychological studies of this time was over-reliance on introspective reports. In these reports, information was acquired by asking subjects what they felt, thought or saw, heard etc. and these reports were then used for deriving psychological principles. This was around the same time that Freud proposed the idea of unconscious processing. We now know for sure that most cognitive processing takes place at an unconscious level.

The criticism of the introspective technique soon led psychology to its opposite extreme and the behaviorist school took over. The behaviorists argued that anything that we could not observe could not form part of the science of psychology. They coined and exclusively used terms like stimulus, response, reinforcement, conditioning etc. All of these had to do with phenomena that could be converted into some kind of numerical representation. Hunger, for example, was called "number of hours of food deprivation."

Behaviorists relied only on things that could see and rejected phenomena such as memory and imagery as unscientific just because they couldn't think of a way of observing and measuring them.

During the 2nd world war, human factors research and information theory combined to generate the information processing approach. This approach along with several other factors led to the creation of a new field called cognitive psychology. Among these factors was Noam Chomsky's critique of Skinner's book Verbal Behavior. Chomsky in his groundbreaking paper "On verbal behavior" shattered the simple minded behaviorist model of language designed by Skinner. He argued that language was far too complex to be explained by stimulus response alone. Around the same time, computers had emerged as thinking machines, where a lot of similarities with human information processing were coming to the fore. The field o artificial intelligence had also

emerged which sought to make computers that thought like humans and solved problems and learned new things.

Donald Broadbent was working at the same time on attention and visual perception. A lot of experimental work during that time along with Bartlett's classic experiments on memory combined to create what Ulric Neisser called Cognitive Psychology in a book entitled "Cognitive Psychology.

Lesson 02

THE INFORMATION PROCESSING APPROACH

The information processing approach, unlike the stimulus-response model of behaviorism, looks at how input is transformed into output. In other words, what happens between sensation and behavior is amore important question for cognitive psychologists than just which sensation produced which behavior. Cognitive Psychology treats the sensation as bits of information which are subjected to various processes in the mind and ultimately behavior may or may not result from this.

These processes are usually performed in stages. There are also different layers or levels of processing in each stage. We can talk about these layers as levels of description rather than actual process itself. Just as in a computer we can talk about hardware level and software level descriptions of a process, we can also talk about human information processing as having a hardware level description - such as what happens in the brain or nervous system when a sensation occurs – and a software level description – like when we close our eyes to recall an image of that sensation, how are we able to recall the image.

The hardware level description may consist of studying the visual sensation itself. And we can study how the sensory neurons carry the information higher in the system. We can study the visual cortex, the part of the brain concerning itself with visual processing. The connection of visual cortex with other parts of the brain would also come under a hardware level description of the process. Then there are complex processes in the brain we don't know enough about. Afterwards, afferent neurons take the decisions via nerves to the muscles which implement the decision. The above description would be the summary of a hardware level understanding of the different processes underlying visual processing.

A software level description would start at the sensation but then continue with sensory storage, discuss the possibility of a filter underlying selective attention, then move on to short term/working memory which will process and transform the material into something that can be kept in the long term memory. From Long term memory the information is retrieved back into the working memory for use when needed. We will discuss these processes in great detail in the following Lessons so at the moment you shouldn't be too concerned if you don't grasp these concepts straight away.

We have used the example of attention in the Lesson to show how doing two tasks at the same time can impair the quality of performance at both tasks. This has allowed psychologists to generate limited resource or limited capacity models of attention, a topic we will discuss in much greater detail later on in the course.

Cognitive Psychologists generate these descriptions of the different stages of information processing and then they develop models that incorporate these descriptions into new theoretical frameworks. These models are then tested in the laboratory using experiments mostly on human subjects.

Lesson 03

COGNITIVE NEUROPSYCHOLOGY

Cognitive Neuro-psychology describes cognition at the hardware level to use the computer metaphor. The neural architecture of cognition is the basis on which the edifice of the software level is erected.

At this level it is possible to explain many visual and auditory phenomena. Higher level cognitions, however, remain a mystery.

Neuropsychological Methods:

Brain-injured Humans

The study of brain injured humans has greatly enriched our understanding of human cognition. It has allowed psychologists to design split brain experiments which made us aware of the differences between the right and the left hemispheres of the brain.

Brains of Dead People

The study of brains of dead people has also added to understanding of cognition but to a limited extent. The brains of people with certain brain disorders were studied to see if any traces of the illness can shed light on normal brain functioning.

Neuro-imaging

X-Rays have also contributed to our understanding of brain processes. But even more revealing have been Magnetic Resonance Imaging (MRI) and functional MRI (fMRI) scanning techniques. The MRI technique is quite intrusive and yields relatively limited information. The fMRI, however, allows live brain scans and is also less intrusive and radiation free. But it still remains a hardware level understanding of the brain and can never substitute a software level description.

Animal Studies

A really controversial method of studying the neural processes is to study live animals. This method is controversial because these animals are subjected, for example, to brain surgeries where parts of the brain are removed to see how they would function. The conditions in which these animals are kept have also come under question. No doubt, a lot of useful information has been obtained by studying animals but the ethical controversy remains.

The Neuron

There are 70 billion neurons in the brain. A neuron is a specialized cell that transmits and stores information of different kinds. The cell body contains a nucleus at its centre which governs the functions of the neuron. There are tiny branches connected to the cell body called dendrites which bring information to the neuron from other neurons. On the other side neuron has a branch called the axon which transmits information from the neurons to the muscles.

The synapse

The neuron is not directly connected to other neurons. A fluid called the neurotransmitter moves between the dendrites from one neuron and the axon of the other neuron. The gap between the neuron which contains the neurotransmitter is called the synapse. It is the synapse which transmits the electric impulse generated in one neuron to the other neurons.

Organization of the Brain

The brain can be divided into four lobes: Occipital lobe, frontal lobe, temporal lobe and parietal lobe. In each lobe are performed certain specialized functions.

Several attached pictures describe different features of the neuron, synapses, and brain organization. Study these pictures to get a broad idea of how the brain structure is organized.

Lesson 04

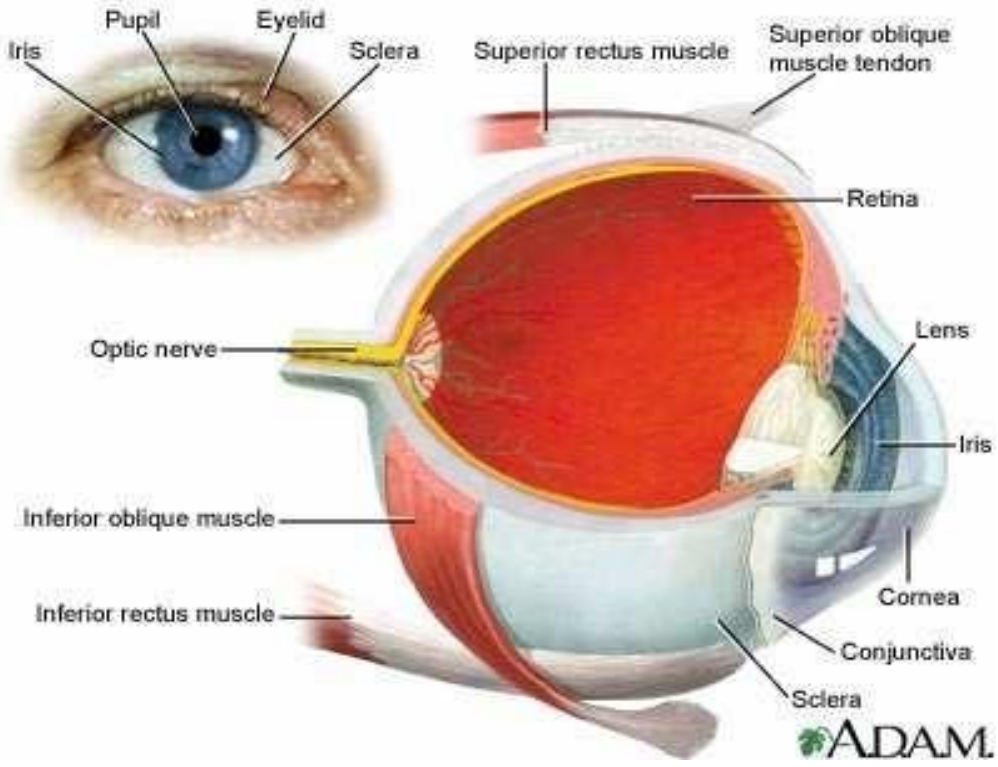
COGNITIVE NEUROPSYCHOLOGY (CONTINUED)

Cognitive Neuropsychology describes cognition at the hardware level to use the computer metaphor. The neural architecture of cognition is the basis on which the edifice of the software level is erected.

At this level it is possible to explain many visual and auditory phenomena. Higher level cognitions, however, remain a mystery.

The Eye

The following diagram of the Eye describes its different parts.



Visual information passes through the lens which helps focus the image on the retina. The information goes from the retina to the optic nerve which transmits it to the brain.

Ibn-al-Haitham

The following diagram gives us a glimpse of contributions by Ibn-al- Haitham, a great Muslim scientist, who had not only discovered the structure and the function of the eye but also how it links with the nervous system.

Ibn-al-Haitham had not only proposed that the eyes transmit the information to the brain via the optic nerve but was also aware of the different visual fields in the eye and had also proposed a dual visual pathway system. Among his other contributions was the development of spectacles and telescopes.

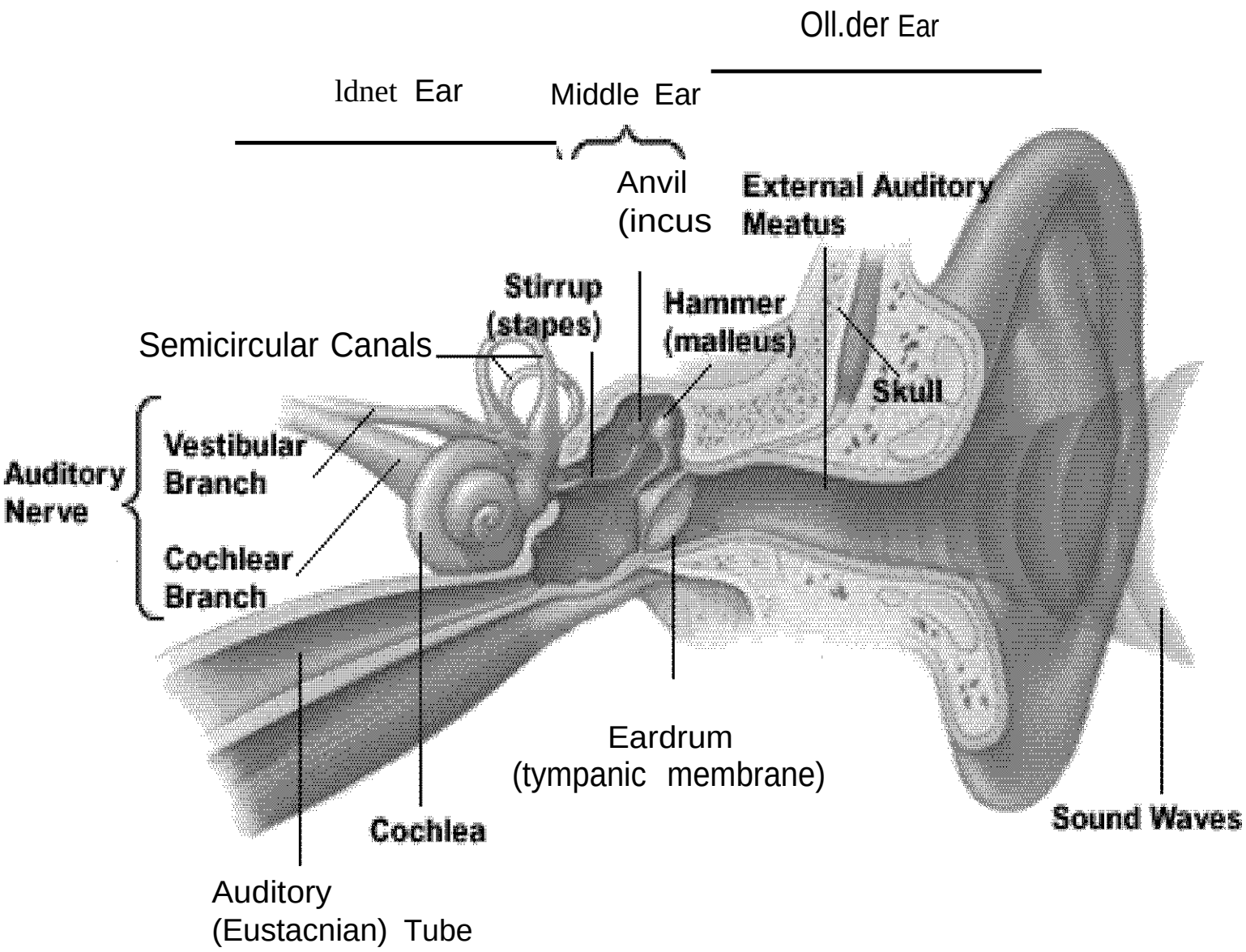
The visual pathway

The visual pathway can be simply described as starting from the retina where the image is formed to the optic nerve. From the Optic nerve the information goes to the optic chiasma where the visual information from the two eyes is combined and then moves on to the lateral geniculate nucleus. The geniculate nucleus processes information about colors and details of the image. Another visual pathway takes the information about global features such as localization and movement to the superior colliculus.

There is by now considerable evidence that there isn't one but two different visual pathways that take different features of an image to different parts of the brain.

The Ear

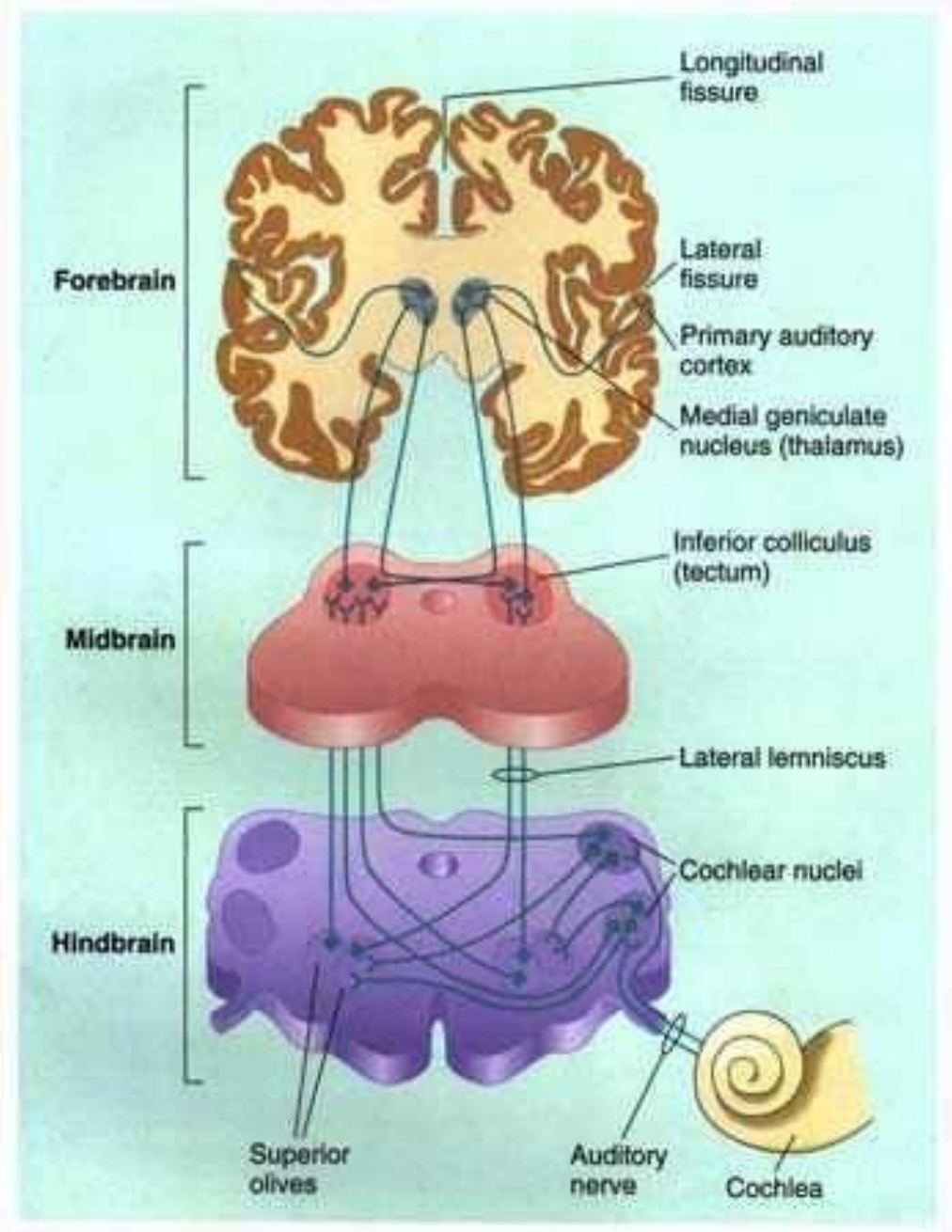
The following diagram shows different parts of the ear:



The auditory information in the ear comes in the form of sound waves and impacts the ear drum. From this the information is transmitted via Cochlea to the auditory nerve.

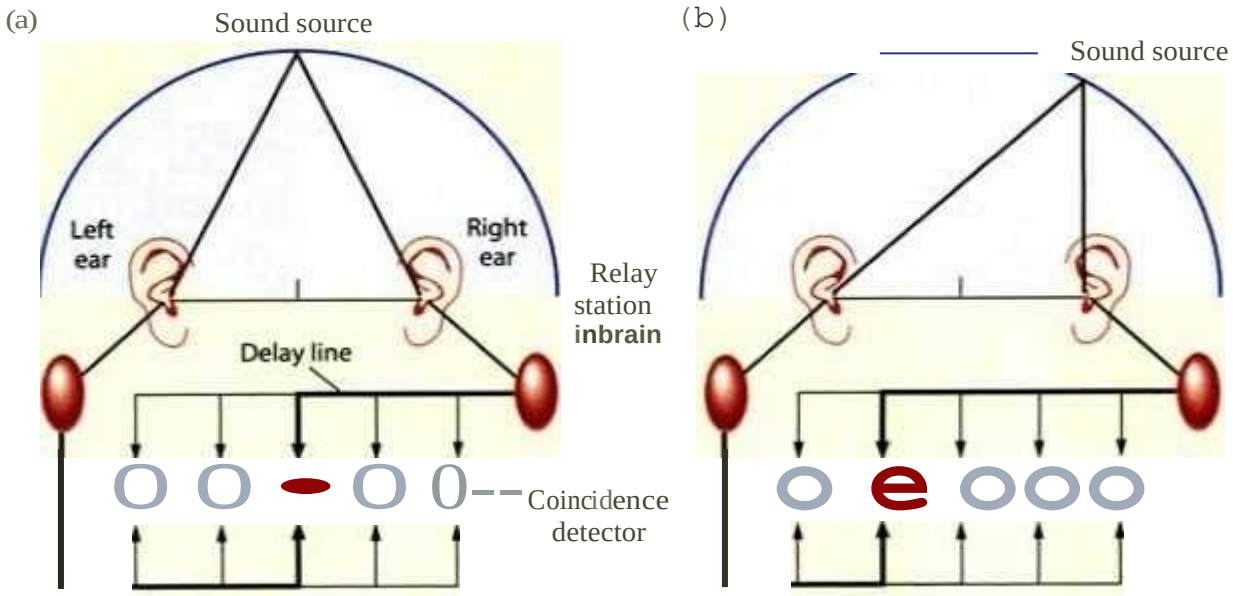
The Auditory Pathway

The auditory pathway is shown in the following diagram:



Sound Localization

The simple architecture of sound localization – information about where the sound is coming from – is described below. There are delay detectors in the nervous system. These delay detectors are connected to each ear and process information about which ear got the information first and which got it later. Depending on the delay between the ears it determines which direction the information came from.

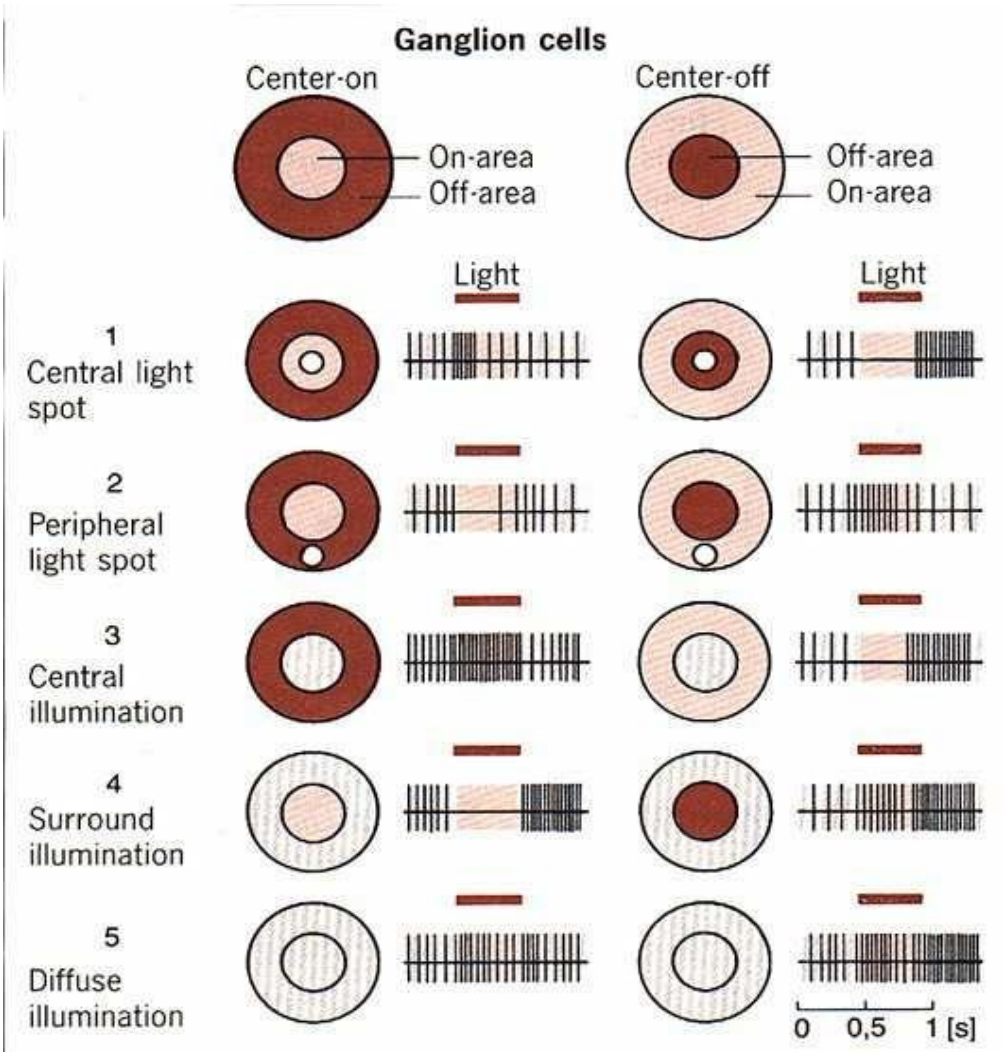

(a)
Sound source
Left ear
Right ear
Delay line
Relay station in brain
Coincidence detector
(b)
Sound source

Lesson 05

COGNITIVE PSYCHOLOGY (CONTINUED)

Information Processing in Visual Cells

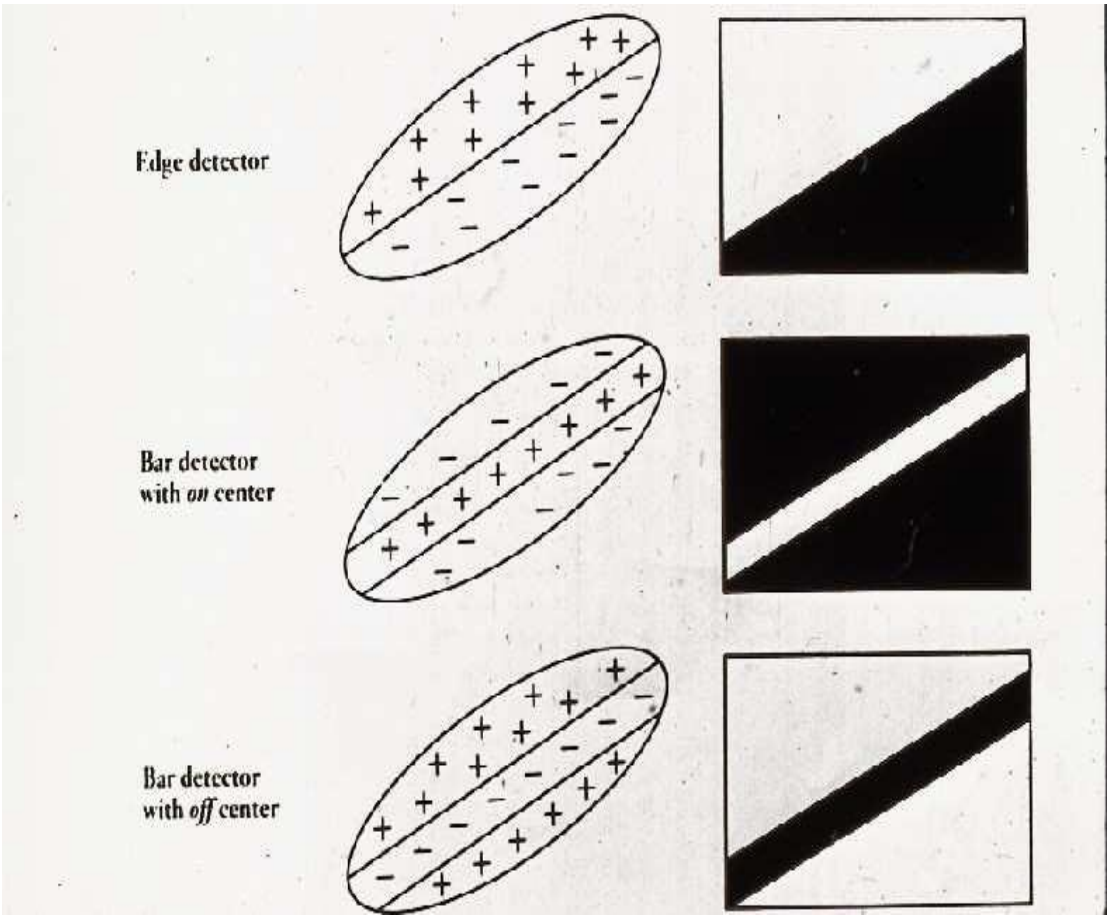
Information processing (of visual information) is done in our visual cortex. Different classical experiments were conducted to understand how do sensation transform into perception? One experiment was conducted by Kuffler in 1953. Kuffler studied ganglion cells in order to understand how sensation transforms into perception and he discovered on-off and off-on cells. These cells define visual information processing. If the light fell on the centre of retina, on-off cells were activated, if the light fell on the periphery, off-on cells start firing. In figure of Ganglion cells there are on-off cells on the left side. On right side there are off-on cells. Lines indicate the activation of neuron and it also indicating the generation of electrical impulses. When light fells on centre of retina the on-off cells start firing. When light fells on peripheral on-off cells are not firing. At this point off-on cells activate. When light is on centre on-off cells work and off-on cells do not work. When there is illumination on surrounding point on-off cells become silent and off-cells start work. When there is diffuse illumination both cells firing slowly. This all is happening at ganglion cells level. Before going visual cortex, the visual system has started processing. The ganglion cells processing is given in following figure.



Hubel & Wiesel

Another important experiment was conducted by Hubel & Wiesel in 1962. They started their experiment with cats. They used visual cortex of the cat. They showed different stimuli, lights and shapes to cats and then they viewed cortical cells are more complex. They found that visual cortical cells responded in a more complex manner than lower cells. They named those cells bar detectors and edge detectors.

Edge detectors help us to understand where an object ends and other starts. Edge detectors respond positively to light on one side of line and negatively to light on the other side. And Bar detectors respond positively to light in the center and negatively to light at the periphery, or vice versa. Both bars and edges detectors are specific with respect to position, orientation, and width. That is, they respond only to stimulation in a small area of visual field. Bar and Edge detectors combine to see a lot of objects as shown in the figure.



David Marr's Work

The David Marr developed a computer model of how information from the on and off cells could be used to yield a useful analysis of the visual image. He developed a model in which computer like human beings assimilate on-off cells.

Marr and Hildreth (1980) combined the output of off-on detectors to calculate bars and edges of various widths and orientations.

In computer system symbolic descriptions were created. Boundaries of objects in the real images pose a difficult problem in computer vision. This system combines the symbolic description to identify the contour of an object.

The following picture is showing different things grass, colorful clouds etc. Human mind detect different things. Like human mind this computer is made to understand different boundaries of image.

Sensory Memory

When information first enters the human system, it is registered in sensory memories**.** Sensory memory allows us to take a snapshot of our environment, and to store this information for a short period. Only information that is transferred to the other level of memory will be preserved no more than for a two seconds. Sensory memory holds a short impression of sensory information even then the sensory system does not send any information anymore. There are 5 basic senses. These are:

1. Vision
2. Hearing

Most of the work has focused on vision and hearing. This is because technology is also quite advance in hearing and vision like camera, microphone and computers etc. Computer can receive voice command and also can produce speech.

The others are:

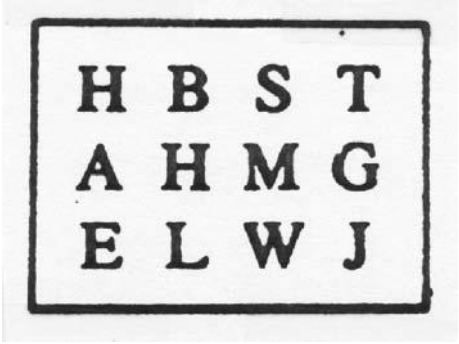
3. Smell
4. Taste
5. Touch

Visual Sensory Memory

Iconic Memory

It can store a great deal of memory only for a very brief period of time. In human experimentation, the subject is made to sit and is asked to look at a screen, a computer screen normally. A dot is shown on the screen with blank white screen (do is located in the center) and the subject is asked to focus on the dot. Instead of dot, a set of letter is presented at that fixed point, where the subject is focusing. After a very brief period letters (stimuli) are removed.

Subjects are asked to report items. Subjects normally reported only 4-5 items out of 12 letters. The set of stimuli is following



Sperling's partial report procedure

An experiment was conducted by Sperling in the field of visual sensory memory. In that experiment the same array of letter was presented to the subjects but the subjects were asked to report the letters according to the cue (a beep in this case an auditory cue). After the array was turned off, a tune was sounded high, medium or low.

High tone cue for reporting the top row

Medium tone cue for middle row

Low tone cue for Bottom row

Better performance

High tone – HBST (subject to report the first row)

Medium tone – AHMG (subject to report the second row)

Low tone – ELWJ (subject to report the third row)

Subjects reported at least 3 out of 4 letters, no matter whether it was on top row or middle row or bottom row. It was very significant. Because the subject did not know beforehand which row will be cued, they had to have three letters from each row available to them. So they had at least 9 out of 12 letters available in their visual memory

Sperling's method was called the partial-report procedure.

The decay in visual memory

Sperling also varied the length of the delay between the offset of the display and the tone. As the delay increases to 1 second, subjects' performance decays back to the original whole-report level of 4 or 5 items. As the graph is showing. It indicates our visual memory lose most of the information in one second.

The decay in visual memory

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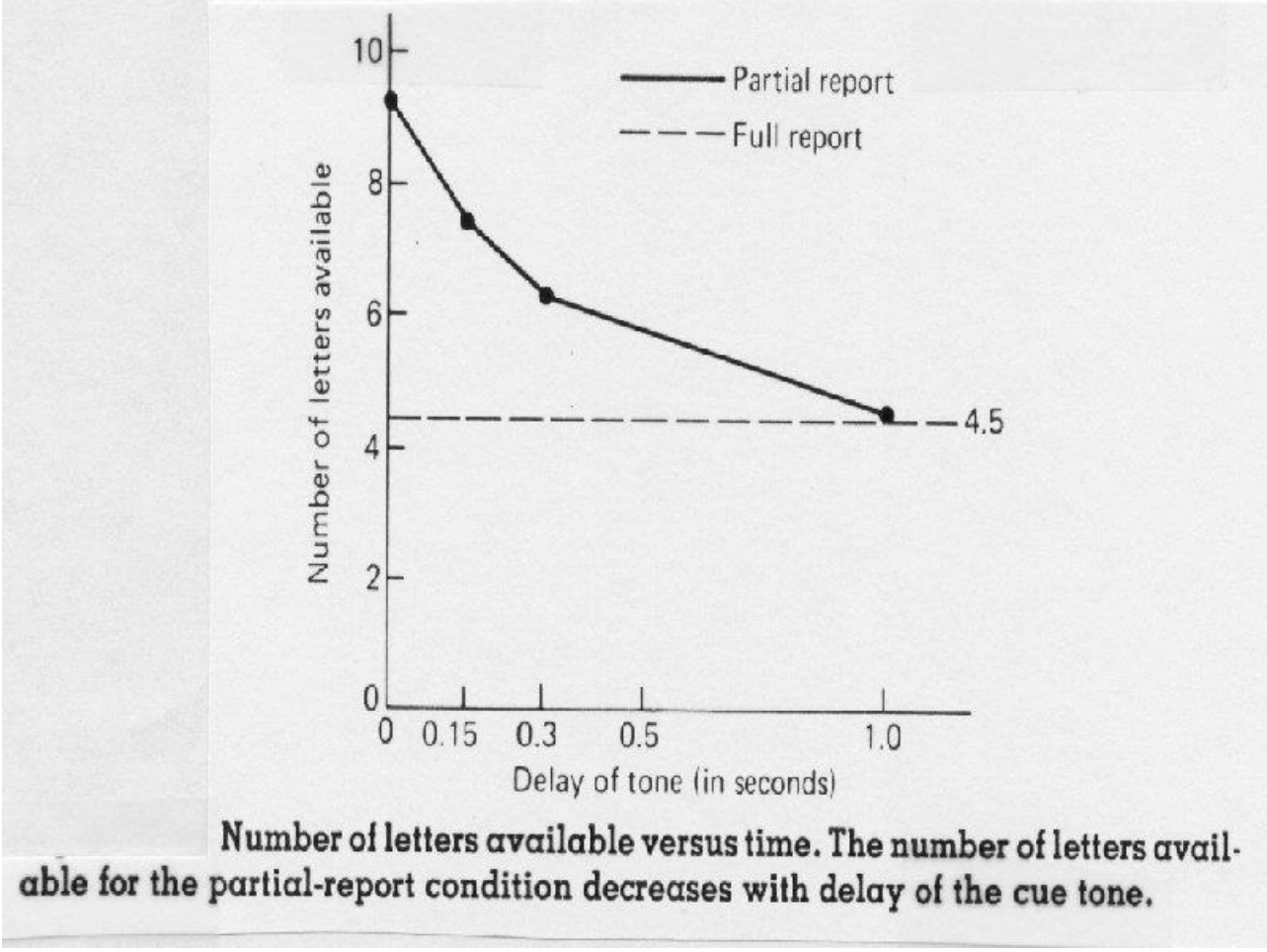


Number of letters available versus time. The number of letters available for the partial-report condition decreases with delay of the cue tone.

The criticism on this experiment was that it is an artificial or laboratory phenomenon. It is not related to real life vision.

Sperling's experiments indicate the existence of a brief visual sensory store- a memory that can effectively hold all the information in the visual display. We receive a lot of visual information from our surrounding but this all store in our visual sensory memory for a very brief period. That information receives attention, stored in our memory other is lost.

Lesson 06

VISUAL SENSORY MEMORY EXPERIMENTS (CONTINUED)

Sperling (1967) & Neisser (1967)

Sperling made another variation and after that array disappeared, he made visual field dark instead of white. This produced fascinating results and the retention power of the subjects was increased to 5 seconds. He found that when the postexposure field was light the sensory information remained for only a second, but when the field was dark it remained for a full 5 seconds.

Light post-exposure field – 1 second

Dark post-exposure field – 5 seconds

Ulric Neisser wrote first cognitive psychology book in 1957. He devised a word ***icon.*** It is a brief visual memory revealed in these experiments. He devised the word iconic memory for short term visual memory.

According to Neisser, the visual memory is neither short term memory nor long term memory but it is very very short term memory and should b called as iconic memory. Without such a visual icon, perception would be much more difficult. Many stimuli are of very duration. In order to recognize them, the system needs some means of holding on to them for a short while until they can be analyzed.

Neisser also reported that if another display is given during that one second when you are already retaining an image it is like erasing or washing out the first and overwriting the second one. Almost all the information is held for a very brief period (1 second). It is quickly washed out after removal of stimulus unless attention is paid to it.

The sensory store is particularly visual in character and is sensitive to light. We cannot pinpoint where sensory memory is located in brain (this is a software level description not hardware level description). Sensory visual store is not physical but seems like physical phenomenon and is sensitive to light.

Psychological Time

Are we living in every moment in this moment or are we living in the past? The conclusion is drawn about that how we are judging that we are living in present not in past. Our new information synthesis with our old information, as it is happening at the same time at the same space. If we see the things that happen before one second we perceive it as it is happening here and now. We are attending to the visual information after some delay no matter how brief that period may be less than one second. And if we perceive the information after we have seen something. We know that we are not living in past we are seeing things here and now. This is called psychological time. We found that our perception is delayed by a second. Our visual system is recombining things within a second and putting them together and constructing a visual image based on the information we receive.

Auditory Sensory Memory

Evidence for an auditory sensory memory similar to the visual memory comes from the set of experiments by

Moray, Bates and Barnett (1965), and

Darwin, Turvey & Crowder (1972)

Moray, Bates and Barnett (1965)

Their experiment is copy of Sperling's experiments. But in this experiment instead of top, middle and bottom, sounds were manipulated as coming from left, right or from the front side. The cue was presented visual (opposite to the sperling's experiment, where the cue was auditory). In their experiment, subjects listened to a recording over stereo headphones, hearing three lists of three items read simultaneously. Because of stereophonic mixing, one list seemed to come from the left side of the subjects head, one from the middle, and the one from the right side. The investigators compared results from derived from a whole-report procedure, in which subjects were instructed to report all nine items, with partial-report procedure, in which they were cued visually after the presentation of the lists as to whether they should report the items coming from the left, middle, or right locations. A greater percentage of the letters were reported in the partial-report procedure than in the whole-report procedure. It was statistical significance**.** Statistical significance means obvious, marked difference.

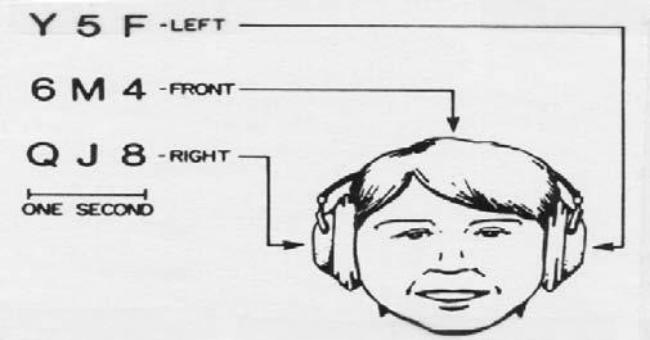
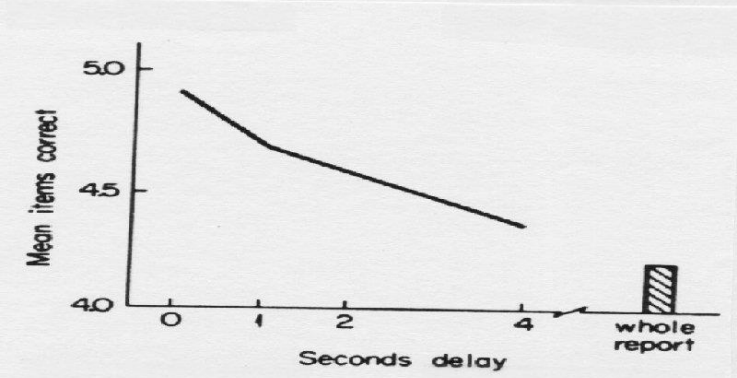


Illustration of stimulus presentation procedure for auditory partial report experiment by Darwin, Turvey, and Crowder (1972).

Thus all the information is available to the short term sensory storage, but it quickly decays. The delay is significant but not striking as compared to visual sensation because visual sensation is central and hearing only supports it. Neisser (1967) has called it echoic memory.

Neisser pointed out many things we understand, perceive but cannot perform them, like the difference between competence and performance. This was a big blow to behaviorism. Cognitive psychology scientifically proved that psychology is much more than observable behavior only. Neisser conclusion was whole-report paradigm was a limit to our production not to our process. We process every thing but we cannot produce all. Time delay, overwriting, light contrast intervene in the production aspect not in the storage aspect.



Results of auditory partial report experiment by Darwin, Turvey, and Crowder (1972). Maximum possible correct is nine.

Psychological time

We all are living in the past. This past is not in passive term. Because we receive visual information that is one second old. And we receive auditory information that is 5 seconds old.

Information is not only being received but also is being reconstructed. We are creating the reality afresh, every moment. Every icon is separate entity. New information is different entity. It reconstructs reality with combining other entity. The heart of cognitive psychology lies in its experimentation.

Lesson 07

ATTENTION

Attention is a perfect example of a cognitive psychology area. Philosophers and Scientific Experimenters unite again to unravel attention. Philosophers theorize and scientists experiment to reach the same goal. Computer scientists help us with simulation e.g., a camera attached with computer. Cognitive psychologists also work with computer scientists for making simulations, although this is not their primary job.

From Sensory Memory most of the information is discarded. Some of it is selected for further processing. Attention plays a crucial role in this stage of selection of information.

What is attention?

Attention is conceived of as being a very limited mental resource. Numerous metaphors can help us to think about the limited-resource characteristics of attention**.**

Some common metaphors;

Is it a spotlight? A beam? (On stage)

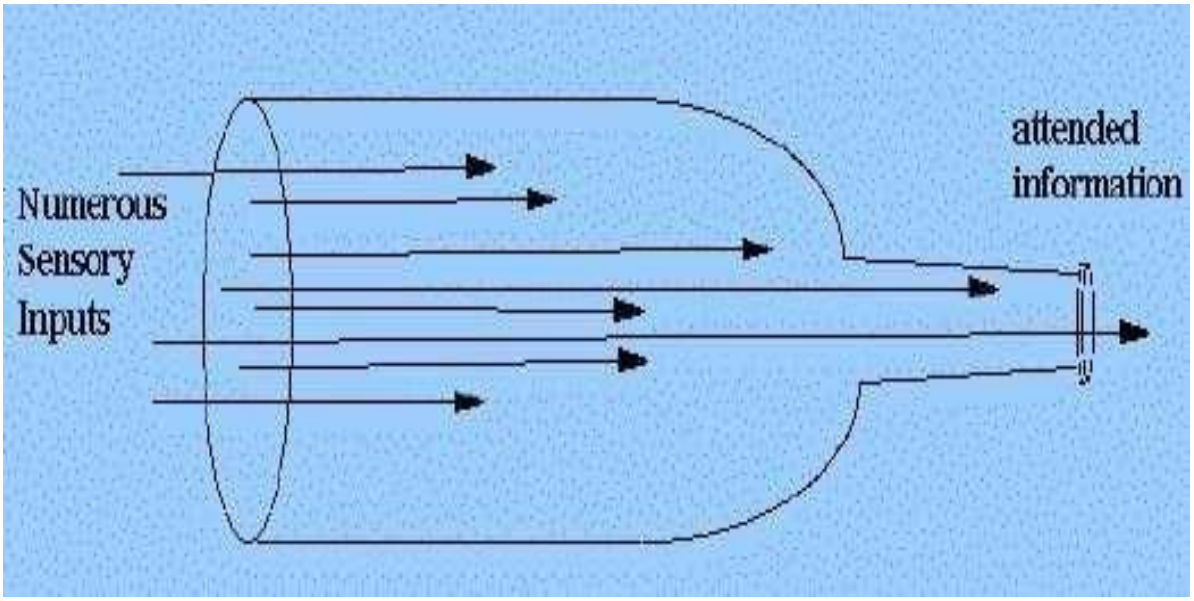
One person is standing on stage and the beam light is just fallen on him not on whole stage.

Is it a filter? A sieve (dirt is thrown, flour)

Like you are standing in a party you just listen those people in which u r standing.guest tunes in to one message and filters out others.

Is it a bottleneck? a narrow lane? (not enough liquid, traffic can flow)

Attention: A bottleneck?



This figure is showing just attended information comes out.

Is it a limited resource? (petrol, manpower etc.)

Like skilled manpower. Countries have a lot of manpower but highly educated people are few. Limited metaphors are;

Energy: We use electricity according to its capacity. If attention is powered by a fixed electrical current. Given the fixed energy supply, attention would be allocable to only so many tasks. If allocated to more, the performance would degrade or a fuse would blow.

Spatial or workspace: in workspace only so many tasks can be performed. Like hundred employees are not fitten in a small room. We fit few people in small room.

Demons: attention as a small set of agents like demons, that can perform tasks but only one at a time.

Single-mindedness

Attention is single-minded sense so it is not double-minded sense. In terms of metaphors, this single-mindedness would mean that only enough energy, only enough workspace, or only a single attention demon was available for one task or process. So it means one thing at a time. Attention is a demanding task. It has a capacity to perform only one demanding task. Attention can't perform two demanding tasks simultaneously.

But what about walking and talking? Driving and talking, and smoking? Because tasks that are practiced to the point at which they do not make excessive demands can be performed simultaneously. We cannot simultaneously do mental addition and carry on a conversation is that each activity in itself involves multiple attention-demanding subcomponents. So it is clear that whether or not attention is truly single-minded, its capacity is severely limited.

Limitations in sensory tasks

The limited capacity of attention is the root cause of the reporting limitations demonstrated in visual and auditory reporting tasks. Attention appears to be the real reason for whole report performance. Limitations of the icon and echo are actually the limitations of attention. All the information gets into sensory memory, but to be retained, each unit of information must be attended to and transformed into some more permanent form. Sensory information needs to be stored in a form that can be retained. Selection for this transformation happens only to attended items. Most information is lost because attention has limited capacity.

Dichotic Listening Tasks

Cherry (1953); Moray (1959) conducted an experiment on how subjects select what sensory input they attend to. This experiment has involved a dichotic listening task.

In dichotic listening experiment subjects wear a set of headphones. They hear two messages, one ear presented with one message, the other ear with another message. Subjects pay attention to (shadow) one message and tune out the other. Psychologist discovered that very little about the unattended message is processed in a shadowing task. Subjects cannot tell what language was spoken or report any of the words spoken even if the same word was repeated over and over again. Subjects reported hearing very little from the other ear

In Shadowing Paradigm

The messages come in Left Ear are: ran, house, Ox, Cat….

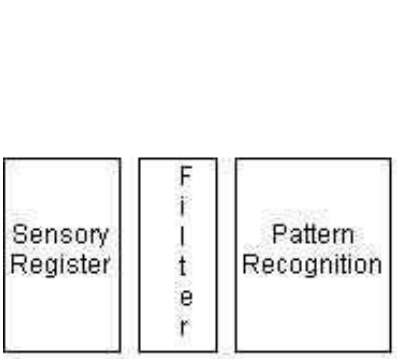
In Right Ear the messages come are: Tea, job, books, look….

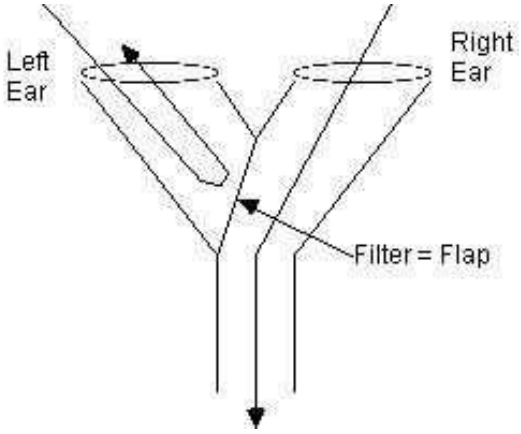
People are asked to attend to left ear. Then they report the messages that came from left ear: ran house, Ox, Cat. And they report nothing from the left

Early Selection Model

Early selection means information is selected early, soon after the sensory store. It happens early on in this system. Higher level processing is not done. The meanings of the words do not have an impact at this stage in this model. The attention must be itself is a lower level process.

Early Selection Model





The figure is showing that information is coming from right and left ears. But before going to bottom line information from one ear is blocking other ear's information. So according to this figure attention is early selection process and low level process.

Attention and meaning

Two undergraduates at Oxford, Gray and Wedderburn (1960), conducted an experiment. And they demonstrated that subjects were quite successful in following a message that jumped back and forth between ears.

Shadow meaningful messages that were given to the subjects were;

Left Ear: John Eleven books

Right Ear: Eight writes Twenty

Instructed to shadow the meaningful message, subjects reported: John writes books. Thus, subjects are capable of shadowing a message on the basis of meaning rather than physical ear.

Lesson 08

ATTENTION (continued)

Attention and meaning

Two undergraduates at Oxford, Gray and Wedderburn (1960), conducted an experiment. They said if attention is low level process and select early, then the meaning should not be important. And they demonstrated that subjects were quite successful in following a message that jumped back and forth between ears. Shadow meaningful messages that were given to the subjects were:

- Left Ear: John Eleven books
- Right Ear: Eight writes Twenty

Instructed to shadow the meaningful message, subjects reported: John writes books. Thus, subjects are capable of shadowing a message on the basis of meaning rather than physical ear.

Implications

In this experiment subjects switched some information and select meaningful words whether they were presented in left ear or right ear.

So this experiment proved attention can use meaning that is a higher level process. Attention is probably not an early selector but a late selector.

Triesman's experiment

Treisman (1960) conducted an experiment to know are the attention is early selector or late selector. In this experiment subjects are asked to shadow message in Left ear. The messages are:

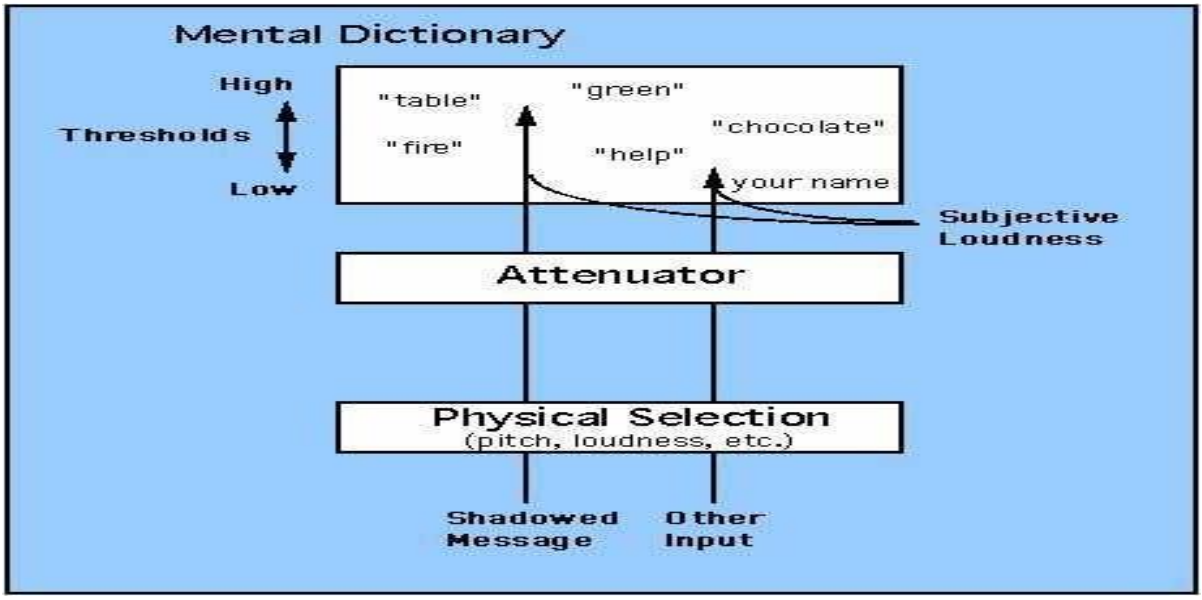
- In Left area: I was going there when/ China, smoke, lovely, chirping
- In Right Ear: books, chairs, tables, elephant/ I saw a bright flash

Many subjects switched ears to follow the meaningful message.

Attention models

1. Treisman's Model

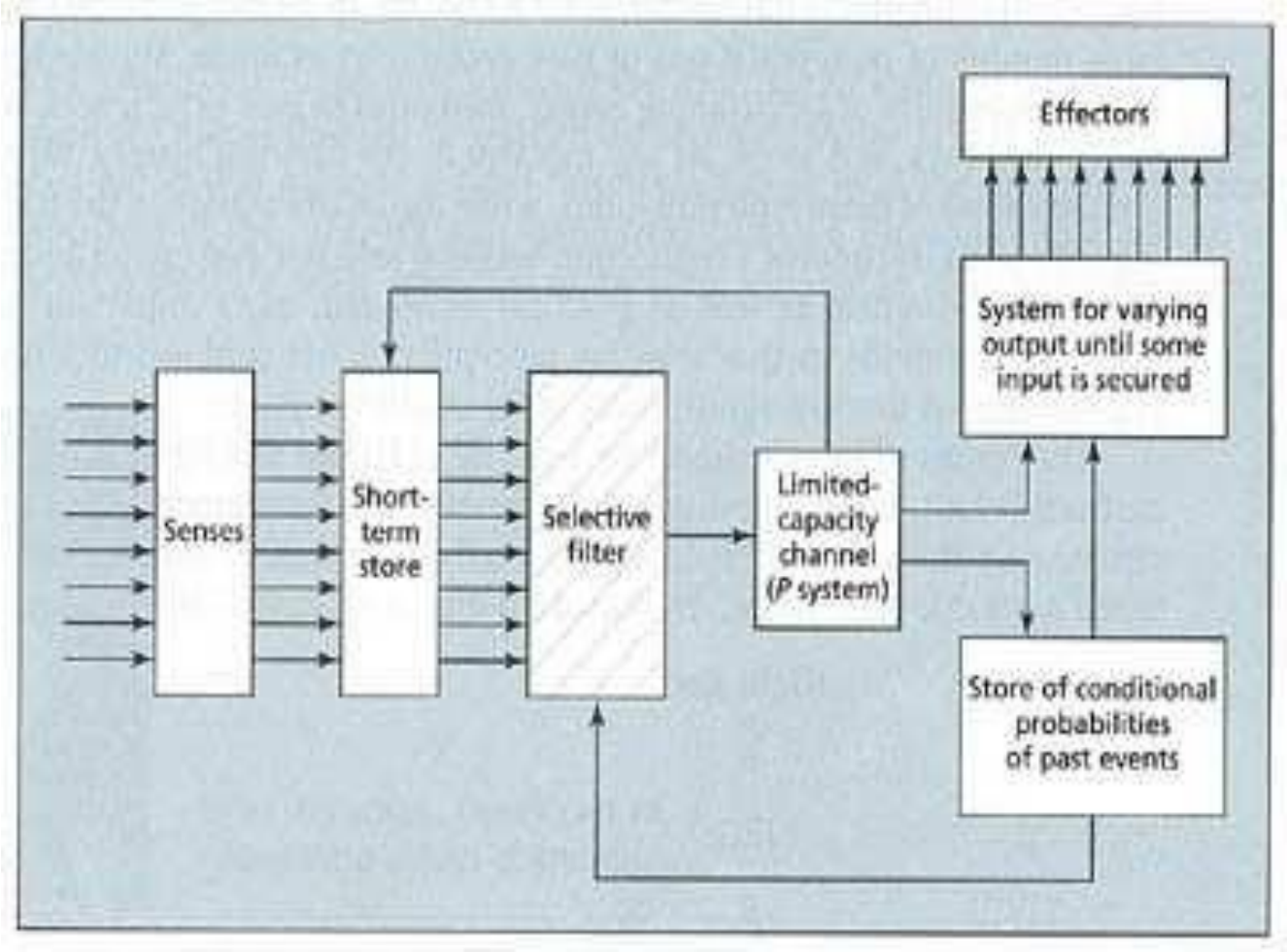
Trisemen gave early selection model according to his experiment. In this model at bottom there are shadow message that is to which attending and other message is other input. She said there is not filter there is attenuator. Attenuator weakened unattended signals. After attenuator information is processed in mental dictionary where some things are very important than other. Like our name is important rather than table or fire. This model explains selection on the basis of meaningful information. This all is showing in this figure..



2. Broadbent's experiment

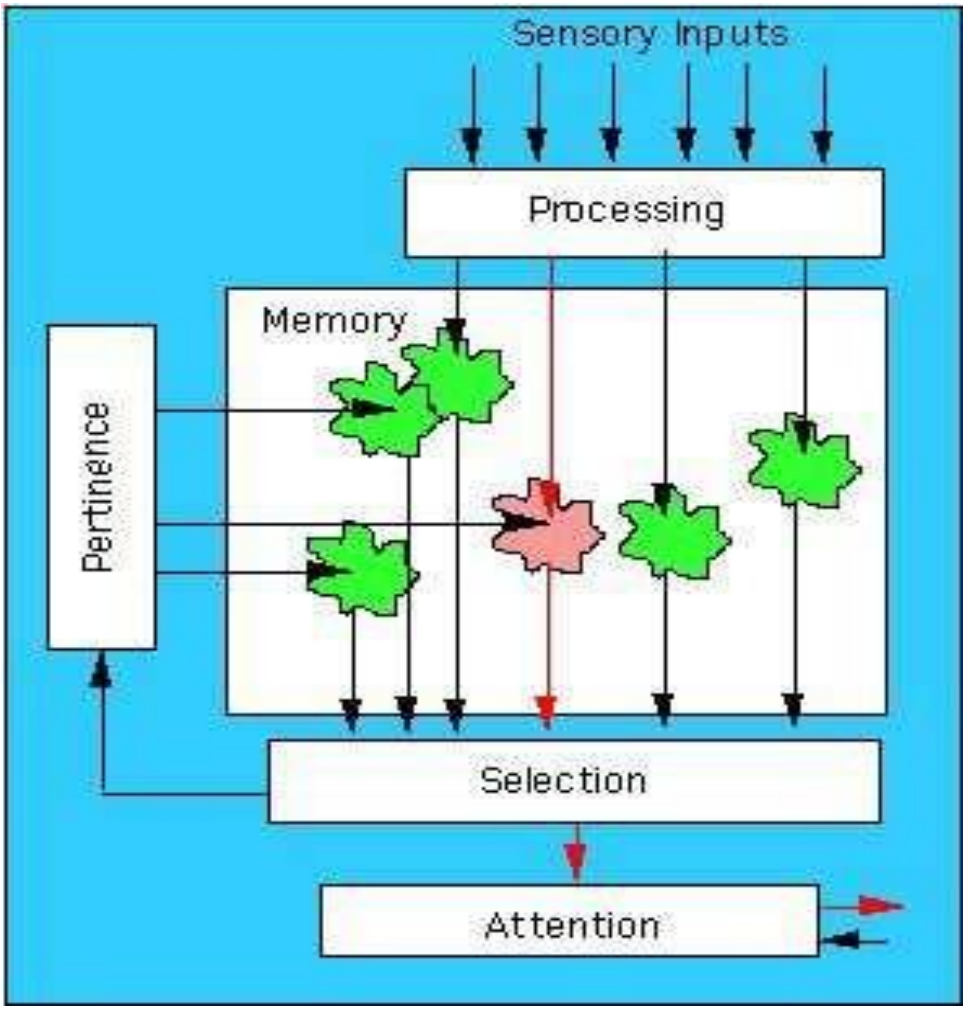
He was working on how skill created. And information processing his model shows senses take information within their limited capacity. Then this information goes in short-term store. Short term store is limit less because all the information is retained that receives by senses but only for a very brief period. This short term store is sensory store. Then the selective filter tune out extra information and pass selected information. Then limited capacity channel pass the important information to other channels. One is going back toward short term store that is feedback loop. Limited-capacity channel pass information to the store of conditional probabilities of past events. This also moves again towards selective filter. Then information is going to system for varying output until some input is secured channel. And then depending on what is happening we move towards effectors. It means our physical response towards attention. The most important thing in Broadbent's model is selective filter is soon after short term store. This models does not select on the basis of meanings.

Broadbent's Model



3. Norman's Model

Another model is given by Norman. This model is not very popular. Norman tried to explain attention is late selector. He said we get all information that store in short term memory than in long term memory. In long term memory we check its relevance when relevance is done we select information and then pay attention. This is opposite model.



There are two most important models:

1. Early selection model
2. Late selection model

Early selection model also are of two types one uses filter that is given by Broadbent and other model uses attenuator that is given by Triesman. Filter model means filter some things are pass and some are stopped. Attenuator means some information is weakened and some strengthens. In Mental dictionary some things are very important for us. These things are strengthens bye attenuator.

Lesson 09

ATTENTION (continued)

Capacity Models

Psychologists have become more interested in capacity Demands of different tasks (Kahneman, 1973). Like there is information coming in and then goes to filter and only relevant information is selected. Different tasks different demands attention diverted to one task to other task. Tasks require mental effort. People may have some control over where the bottleneck occurs (Johnston & Heinz, 1978)

Kahneman's Capacity Model

Attention and Effort" was a major work of kahneman (Kahneman, 1973). He shifted the focus from bottleneck to capacity. There is flexibility in attention, like we can change our attention from one thing to other thing. There is a lot of evidence that our bottle neck is actually adjustable and it can be move early to late. A general limit on a person's capacity to perform mental work. A person has considerable control over how this capacity is allocated.

Daniel Kahneman

He has been doing his work at Princeton University. He has been a pioneer of cognitive psychology not only in the area of attention but on other areas.

Kahneman's Capacity Model

In this model there are many miscellaneous determinants that impact sensory system. Something happens that trigger arousal. Arousal means some activity starts. Arousal has many manifestations. Available capacity of attention will be allocated depending on the state of arousals. So there is allocation policy. Then there are some possible activities. Like the amount of attention is paid on a task. At the same time there is a feedback loop. We evaluate how much attention is needed for the task. Then we readjust more capacity to that task.

The factors that have impact on allocation policy are:

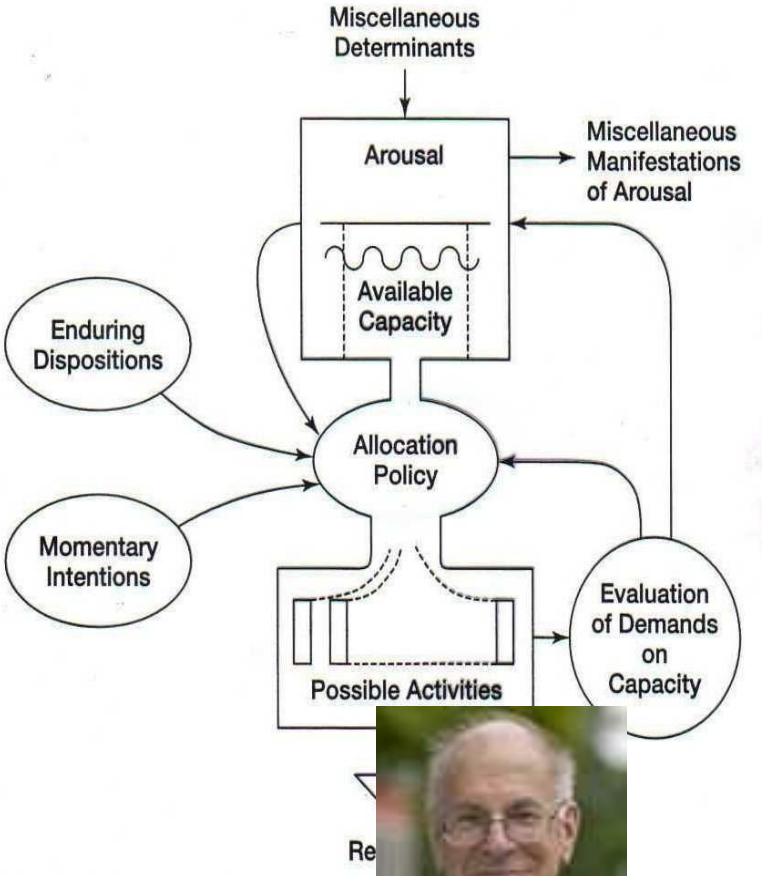


FIGURE 3.3
Kahneman's capacity model of atten . 1973. Attention and Effort, *Englewood Cliff* d by permission.)

Arousal

A physiological state that influences the distribution of mental capacity in the various tasks.

Enduring Disposition

An automatic influence where people direct their attention.

Monetary Intentions

A conscious decision to allocate attention to certain tasks or aspects of the environment.

Example: World Trade Centre

Boeing 707 flying in cloudy weather, at an altitude 200 feet below the top of the WTC was reported by the airport controller. Alarm buzzed in the airport control tower to signal the danger. The controller radioed the crew to turn around and climb up to 3000 feet. The controller was monitoring seven other planes at the time. His attention was diverted to other planes so he could not pay attention to that plane. So alarm diverted his attention toward that plane.

Bottleneck vs. Capacity

Both models predict that simultaneous activities are likely to interfere with each other. They attribute the interference to different causes.

***Bottleneck*:** according to this model same mechanism required to perform 2 incompatible tasks. It is specific. It says same mechanism id needed to those tasks.

Capacity: Demands of 2 activities exceed available capacity then there is problem. It is non-specific to the task. Total demands of the task, is an important variable.

Both kinds of interference occur (specific and capacity, early selection and late selection.)

Both kinds of theories are necessary.

Capacity & Stage of Selection

All experiments are showing flexibility of attention. It means we can divert our attention from one task to other task.

These are also showing an interaction between bottleneck & capacity theories (Johnston & Heinz, 1978). Listener has control over the location of the bottleneck.

The location can vary from early mode of selection (before recognition) to late mode of selection (after semantic analysis means meaning analysis).

There is a need to combine capacity model and stage of selection.

Multimode Theory

A theory that proposes that people's intentions and the demands of the task determine the information processing stage at which information is selected.

Demands of task require greater mental efforts. People's intentions and the demands of task decide where the attention is paid. We select on the basis of meanings if there are two competing tasks.

Early Selection vs. Late Selection

According to this theory both early and late selection can occur. Attention is flexible. We can move our bottleneck and filter. But there must be interaction between bottleneck and capacity. We can shift our bottleneck to the low level in information processing when we pay attention to the physical properties of the task. We have a capacity to switch our bottle neck from early to late or late to early. Late selection will affect the perception of primary message because more information is selected about the secondary task.

Lesson 10

ATTENTION

Multimode Theory (continued)

A theory which proposes that people's intentions and the demands of the tasks determine the information processing stage on which information is selected.

Experiments to test multimode theory

A series of 5 experiments was conducted to measure the amount of capacity required to perform a task and they record how quickly a person responds to a subsidiary task (reaction time). Main task was a selective listening task. In selective listening task there are different voices in both ears. And subjects are asked to attend only one voice or one list and repeat it.

The Subsidiary task was to a randomly appearing light signal by pressing a button.

Subsidiary Task

A task that typically measures how quickly people can react to target stimulus in order to evaluate the capacity demands of the primary task.

Every theory has assumption if experiment fulfills that assumption then we can say our theory is true. Every theory predicts some phenomenon and we test these predictions through experiments. If these predictions meet we accept theory otherwise we reject theory.

Capacity Theory

Main Assumption of Capacity Theory is;

The greater the portion of capacity allocated to selective listening (primary task), the less should be available for monitoring the signal light, causing longer reaction times.

It means if selective listening task has more required capacity then the subsidiary task's capacity to monitor signal light must b less that's why the reaction task is longer.

Reaction Time & Accuracy

The time it takes for the subject to respond to a stimulus is called reaction time. The longer the time taken, the more difficult the task. If the task is demanding, subjects likely to make mistakes and you take long time. Like mathematics is difficult subject. So we make many mistakes in mathematics because it is demanding. If there is more demanding task, the more mistakes and less accuracy. Less demanding task more accuracy. Some time reaction time slow but there is accuracy.

Experiment

In this experiment pairs of words presented simultaneously to both ears through headphones.

Undergraduates at University of Utah were asked to do the following. They were asked you have to attend the different voices. The stimulus were

Either by the pitch of the voice (male/female)
Or by semantic category (cities, occupations)

The conditions of experiment were;

1. No lists

It means no list of stimulus was presented in both of the ears

2. One list

Only one list was presented in one ear. May be male voice or female voice was presented.

3. Two lists

Two different lists of stimulus were presented in both ears. In this condition first understand meanings. It is late selection. In one ear male or female voice was presented. And in other ear different city's names or occupation's names were presented.

The rationale in that experiment was; those using pitch (male/female) were using physical information and could use an early, sensory mode of selection because the two messages were physically different.

Those using meaning (cities, occupations) had to use a late, semantic mode of selection because it was necessary to know the meaning of the word before categorizing them.

Predictions of Multimode theory

Multimode theory predicts that more capacity is required to perform at a late mode of selection.

Use of the semantic mode would therefore cause slower reaction times to the light signal and more errors on the selective listening task. You need more conditions it was late selection it requires more capacity.

In no list the performance is best, in one list condition the performance is better, in two lists condition performance is worst.

Results of subsidiary tasks

Performance on Subsidiary Task

When No list was given the reaction time was 310 ms

When there was one List either female voice or cities names the reaction time was 370 ms

In Two Lists condition (pitch) the reaction time was 433 ms

In Two Lists (meaning) the reaction time was 482 ms

Results of Primary Task

Percentages of Errors

In case of one List the error percentage was 1.4%

In case of Two Lists (Pitch)error percentage was 5.3%

In case of Two Lists (Meaning) error percentage was 20.5%

Implications

The implications of this experiment are;

Selective Attention requires capacity

Reaction Time slower for two lists condition over one

Amount of capacity required increases from early to late selection

Reaction Time slower for meaning than for pitch (male and female).

Summary

-Attention is flexible

-People have the choice how best to use it. People can allocate attention to the task according to their will.

-Task difficulty decreases with practice

Lesson 11

RECAP OF LAST LESSONS

Attention can be explained by bottleneck or filter models as well as by capacity models. Filter models assume that interference in attention is caused by a filter or an attenuator. Some filter models assume that filters occur early, before recognition. Others assume that filter occurs late, after semantic analysis. Capacity Models assume that interference is caused by overload on the capacity.

AUTOMATICITY

Automatic Processing

Tasks vary considerably in the amount of mental effort required to perform them. Some skills become so well-practiced and routine that they require very minimal mental capacity. Cognitive Psychologists use the term automatic processing to refer to such skills. The more a process has been practiced, the less attention it requires, and there is speculation that highly practiced process require no attention at all such highly practiced processes that require little attention are referred to as automatic.

Pros and cons

It allows us to perform routine activities without much concentration or mental effort: it does not require much attention.

Automatic processes complete themselves without conscious control by the subject.

We may make silly mistakes.

We may fail to remember what we did.

We are not able to show others how we do a task.

When is a skill automatic?

According to Posner and Snyder (1975)

A skill is automatic if it:

1) Occurs without intention
2) Does not give rise to conscious awareness
3) Does not interfere with other mental activities

Automaticity: Another Perspective

Shiffrin & Schneider (1977) argue that it is best to think of Automaticity as a matter of degree rather than a distinct category. A nice demonstration of the way practice affects attentional limitations is the study reported by Underwood (1974) on the psychologist Moray, who has spent many years studying shadowing (split attention studies). Moray can report most of the unattended channels, for him shadowing has become automatic. Through a great deal of practice, the process of shadowing has become partially automated.

More experiments

Schneider & Fisk (1982), Schneider & Shiffrin (1977), Shiffrin & Dumais (1982), and Shiffrin & Schneider (1977) performed a series of experiments contrasting controlled vs. automatic processing.

They said automatic processes complete themselves without conscious control by the subject. In the visual and auditory report tasks reviewed earlier, the registering of the stimuli in sensory memory is an automatic process. Many aspects of driving a car and comprehending language appear to be automatic. Controlled processing seems to require conscious control. Many higher cognitive processes, such as performing mental arithmetic, are controlled.

In their experiments, subjects were required to scan visual arrays. The subjects were given a target letter or number and are instructed to scan a series of visual displays for the target.

Visual arrays

1st condition

- J letter to be recognized
- GK
- MF

2nd condition

8 number to be recognized
MN
L 8

The task

Two factors are varied

Each frame has one, two or four characters on it. This factor is referred to as frame size.

The other important variable is the relationship between the target item and the items on the frames.

In the same category condition, the target is a letter as well all the characters on the frame. In the different category condition the target is a number surrounded by letters.

If the target appears on the frame, subject responds yes, if it doesn't appear on the frame the subject responds no.

Results

In the different category condition

Reaction Time was 80 milliseconds, and Accuracy was 95%

In the Same Category condition

Reaction Time was 400 milliseconds, and Accuracy was also 95%

In the Different category condition

No effect of frame size

In the same category condition

Accuracy and RT deteriorated as frame size increased.

Schneider and shiffrin argued that before coming into the laboratory, subjects were so well practiced at detecting a number among letters that this process was automatic. In contrast, when subjects had to identify a letter among letters, controlled processing was needed. In this situation subjects had to attend separately to each letter in frame and compare it with the target. All these steps took time, and thus subjects were able to inspect each frame properly and achieve respectable levels of performance only when slides were presented slowly. Also the more letters that were in a frame, the more slowly in the frames had to be presented, since subjects had to check each letter in the frame separately. In contrast, subjects could check all items simultaneously in the different category situation to see if any were numbers. They were able to perform this processing simultaneously because process was automatic

Implications

Schneider & Shiffrin argued that detecting numbers among letters didn't place any load on the capacity and that is why subjects were not affected by frame size.

Detecting letters among letters however was a hard task which placed a lot on attention capacity which was affected negatively as frame size increased.

Lesson 12

AUTOMATICITY (continued)

Automatic processing

Experiment

Shiffrin and Schdeider (1977) ran another experiment in which the target always came from one set of letters. These Target letters were B C D F G H J K L. And the Distracters were Q R S T V W X Y Z.

After 2100 trials subjects were at the same level of accuracy and RT as the different condition in the previous experiment: thus subjects need 2100 trials of practice before discriminating between two different sets of letters had become as automatic as discriminating numbers from letters.

The results were;

Reaction Time = 80 ms, Accuracy = 95%

Implications

The results demonstrate that processes can become automatic with enough practice

When they do, devoting attention to them is no longer necessary

Performance is no longer affected by the number of processes being performed simultaneously

Five Criteria for Automaticity

Hasher & Zacks (1979) proposed five criteria to distinguish between automatic and controlled or effortful processes. They also made predictions based on these five criteria

1. Intentional vs. incidental learning

Intentional learning occurs when we are deliberately trying to learn; incidental learning occurs when we are not, i.e. Class teachers ask children to do but they do not do themselves. Like, parents say their children do not lie but parents lie themselves. Children learn from parent's and teacher's actions rather saying.

Incidental learning is as effective as intentional learning for automatic processes but is less effective for effortful learning; we know that in Urdu letter "seen" occurs more often than letter "zhe" without trying to learn this information.

2. Effect of instruction & Practice

Instructions on how to perform a task and practice on the task should not affect automatic processes because they can already be carried out very efficiently. i.e. Expert cricketer come in ground and coach says when you see ball hit it. It is not efficiently work because expert cricketer already knows what he has to do.

Both instruction and practice should affect effortful processes. Practice help in learning well.

3. Task interference

Automatic processes should not interfere with each other because they require little or no capacity.

Effortful processes require considerable capacity and should interfere with each other when they exceed the amount of available capacity.

4. Depression or High arousal

Emotional states such as depression or high emotional arousal can reduce the effectiveness of effortful processes. If we are in sad mood and someone give us a difficult and demanding task we can not concentrate on that task and can not learn well. We are not able to learn and pay attention in class room when we are in sad mood.

Automatic processes should not be affected by emotional states. Like, if we have to brush our teeth we can do it even if we are in sad mood.

5. Developmental trends

Automatic processes show little change with age. Once a task is practiced then the age does not matter. They (most of the automatic processes) are acquired early and do not decline in old age.

Effortful processes show developmental changes. They are not performed as well by young children or the elderly. There are many things that old people can not do. Because these tasks are not practiced. Like, if we are teaching math to an old man he can not learn well and easily.

We have to pay attention to all task attention and practice make things automatic. Like a students who has habit of reading he can succeed even if he is not intelligent.

The basic differences between automatic and effortless processes, according to these five criteria are;

Intentional vs. incidental processing

Automatic: no difference,

Effortful: intentional better

Effect of instructions and practice

Automatic: no effects,

Effortful: improve performance

Task interference

Automatic: no interference,

Effortful: interference

Depression or high arousal

Automatic: no effects,

Effortful: poor performance

Developmental trends

Automatic: none,

Effortful: poor performance

Lesson 13

AUTOMATICITY (continued)

Judging frequency

Hasher & Zacks (1984) talked about judging frequency. They said

People are good at judging relative frequency of events.

There is considerable evidence to suggest that this information is encoded automatically.

This knowledge allows us develop expectancies about the world.

Predicting flight performance

Gopher & Kahneman (1971) found that flight attendants frequently emphasized the importance of selective attention in learning to fly high-performance aircraft. Like Pakistan air force has many planes. Flying these planes need sophisticated skills. Then the selective attention is very important. They have to understand which plane needs more attention.

Flight cadets often failed because they could not appropriately divide their attention among simultaneous activities or were slow to recognize crucial signals that arrived on unattended channels.

Gopher and Kahneman tested 100 cadets in Israeli Air Force. In that experiment, two different messages came to different ears through headphones. A tone signaled which ear was relevant. High tone was for right ear and light tone was for left ears. Subjects had to report all the digits from the relevant ear.

There were three groups of cadets.

Group 1: 17 cadets rejected early during training on light aircraft.

Group 2: 41 cadets rejected during training on jet aircraft.

Group 3: 42 cadets had reached advanced training on jet aircraft. Group 3 was best group. Because they had passed advanced training on jet craft.

Results

Results of that experiment were;

Those that made 3 or more errors:

76% of Group 1 made 3 errors or more.

56% of Group 2 made 3 errors or more.

24% of Group 3 made 3 errors or more.

The results showed selective listening task was the best predictor of flight performance. It means selective listening task is more appropriate than other tests in recruitment process.

This has implications for fighter pilot training in Pakistan Air Force as well.

Predicting Road Accidents

Kahneman, Ben-Ishai & Lotan (1973) studied bus drivers.

Accident prone drivers: 2 or more severe accidents in one year

Accident-free drivers: no accidents in the same period

Intermediate drivers: in-between the two groups

Selective Listening task had a high correlation with driver safety. Those drivers performed best in selective listening task they were safe drivers and had low rate of accidents.

Other road accident experiment

Mihal & Barett (1976) used seven tests to predict accident involvement of commercial drivers. They found selective listening task to be the best predictor.

Surprising result was because a visual task was not as good a predictor as listening.

Perhaps because selective listening task is a general measure of attention.

Those good at switching attention in an auditory task are also good at visual tasks (Hunt, Pellegrino & Yee, 1989)

Thought suppression

Wegner and colleagues (1987) studied thought suppression.

We can think anything like pink elephants. Suppose If someone says us to don't think about purple elephants we must think about purple elephant even someone tells us to don't think.

They wanted to investigate the attention to internal sources of information.

They studied

Thought suppression &

Thought expression

There were two situations of experiment.

Suppression: Don't think of a "White Bear"

Expression: Think of a White Bear

For five minutes subjects were put in a situation. Subjects were instructed to don't think of a "White Bear". You must ring a bell whenever you think of a White Bear.

Results

Results shows

Suppression before Expression

Subjects started 3.5 rings down to 1 ring

Suppression after Expression

Subjects started from 4.4 rings down to 1 ring

Expression before Suppression

Subjects started 4.5 rings down to 1.8

Expression after Suppression

Subjects started 4.5 rings up 5.2

Implications

Paradoxical effect of thought suppression is that it produces a preoccupation with the suppressed thought.

Subjects use environmental cues to help with thought suppression which become associated with the thought.

It is better to work on suppression in an environment which is different from one's usual environment.

Remedies for rebound

Competing thought actually reduces the rebound effect.

Instructions to think about a red Volkswagen instead of a White bear reduced White Bear thoughts during expression (Wegner et al, 1987).

Subjects who changed their surroundings had fewer White Bear thoughts (Wegner & Schneider, 1989).

Lesson 14

PATTERN RECOGNITION

We know how information is first recorded by senses and selected for processing by attentional mechanisms. The most criical question for a theory of perception is how is this information recognized for what it is?

Most research has focused on letter recognition or recognition of letters identity: for example how do we recognize ***A*** as an instance of **A**

Template Matching Models

The template-matching theory of perception assumes that a retinal image of an object is faithfully transmitted to the brain. An attempt is made to compare it directly to various stored patterns. These patterns are called templates. So, the basic is that the perceptual system tries to compare the letter to templates it has for each letter and reports the template that gives the best match.

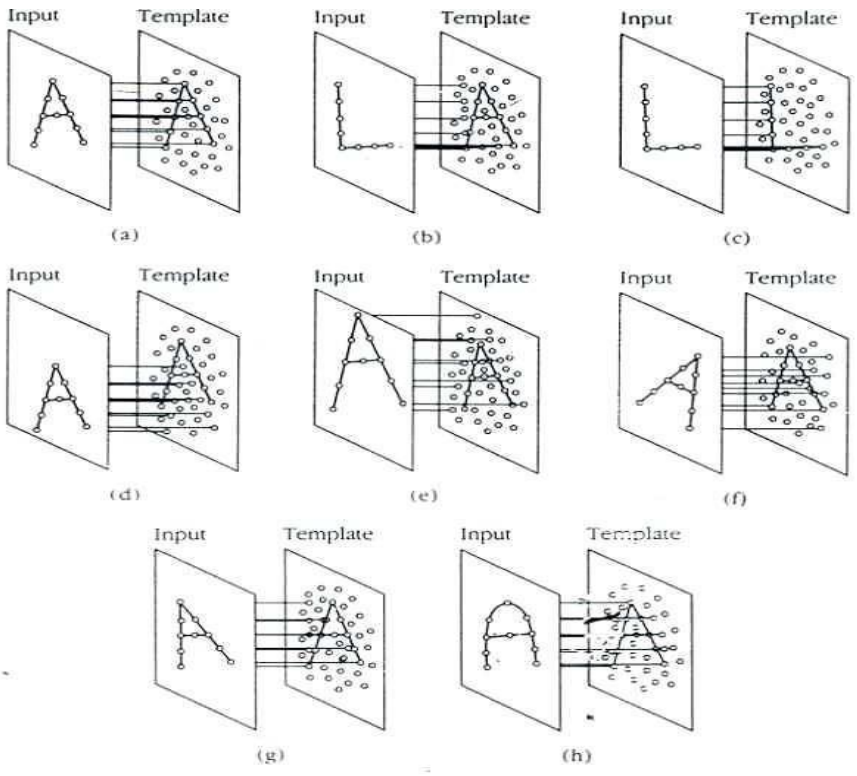


FIGURE 2.13: Examples of template-matching attempts: (a and c) successful template-matching attempts; (b and d to h) failed attempts. (Adapted from Neisser, 1967.)

Figure illustrates various attempts to make template matching work. In each case, an attempt is made to achieve a correspondence between the retinal cells stimulated by the ***A*** and the retinal cells specified for a template pattern.

Input represents retinal cells.

Template matching

The pattern is stored for each retinal cell activated; if different retinal cells are activated there won't be a match. As the figure is shown:

a successful matching

b wrong matching

c successful matching

d wrong part of retina

e wrong size

f wrong orientation

g and h non-standard images

Examples in machines

Some template matching machines are;

Finger-print matching machines. Finger prints machine are template matching machines. These machines match finger prints with criminal finger prints.

Bar code reading machines in shopping stores are also example of template matching machines.

ATM/ Credit card reading machines. These machines match the numbers of ATM card with passwords.

But these are machines that recognize exact matches. Any minor change means there is no match.

Human flexibility

In *Humans* we can recognize LARGE letters and small characters, Characters in the wrong place

and in strange**.**

It means if you meet your uncle after many years even he is in different appearance you can recognize him. This is human flexibility to recognize things, people or places.

Problems with templates

Human perceptual system is much more flexible.

Most patterns we encounter undergo at least some minor changes. Like,

Letters are different font sizes and styles

Shapes change slightly

Orientations are different

But still we can recognize things.

Feature Analysis model

In this model, Stimuli are thought of as combination of elemental or primitive features.

The features for alphabets may consist of horizontal lines _

vertical lines **I**

Lines at approx 45 degree angle /

And curves **(**

Like alphabet **T** has two line one vertical and other is horizontal line both make alphabet **T.** All letters are consisted on these four patterns. Our mind analyzes letters according to these features.

How is it better than template model?

Features are mini-templates but features are simpler.

One can identify critical features for a letter

For A, 2 45 degree angles (/ \) intersect at the top and a horizontal line _ intersects both of these near the middle. the pattern of A consists of these lines plus a specification as to how they should be combined.

These features are very much like the output of edge and bar detectors in the visual cortex.

Example

Many other details are unimportant

So,

A A *A* A A A A A A

All of the above can be recognized as the same letter. Even they are in different shapes and different styles.

In the feature model we do not need a template for each letter but only for every feature, this would be a great saving. We have 26 letters small and capital. If letters have many features in common, subjects are prone to confuse them.

By these four features we can store all 26 letters. English model is also applicable in Urdu letters with the addition of Dot (nukta). Urdu writing is much more complex than English. Urdu reading is also difficult as well.

The feature model has a number of advantages over the template models.

First, since the features are simpler, it is easier to see how the system might try to correct for the kinds of difficulties caused by templates model.

A second advantage of the feature combination scheme is that it is possible to specify those relationships among features that are most critical to the pattern.

Lesson 15

PATTERN RECOGNITION

Feature Analysis (continued)

Example

There is fair amount of behavioral evidence for the existence of features as components in pattern recognition. For instance, if letters have many features in common_as with C and G_evidence suggests that subjects are particularly prone to confuse them. When such letters are presented for a very brief interval, subjects often misclassify one stimulus as the other.

Kinney, Marsetta, & Showman, (1966) conducted an experiment. In that experiment they presented letters for very brief intervals.

The subjects made

29 errors when letter G was presented

21 involved misclassification as C

6 misclassification as O

1 misclassification as B

1 misclassification as 9

No other errors occurred

Implications

It is clear that subjects were choosing items with similar features.

C G O B 9 all share a curve

Such a response pattern would be predicted by a feature analysis model.

If subjects can only extract some of the features during a short time, they would have difficulty deciding between letters that share these features.

Speech Recognition or Auditory Recognition

Recognition of speech poses new problems. It is more complex.

Segmentation is a major problem because speech is not clearly demarcated the way written text is. Native speakers always mix words together in their speechs. They do it unconsciously.

It seems there are clear gaps between words but that is an illusion. For example in urdu;

Kya haal hay and *kya ho raha hay*

The person who does not know Urdu he understands these words as kyaalay and kyaoray. The speech appears to be continuous stream of sounds with no obvious word boundaries. It is our familiarity with our own language that leads to the illusion of word boundaries.

Phonemes

Phonemes are the basic vocabulary of speech sounds; it is in terms of them that we recognize**.** Like,

School [s] [k] [u] [l]

S, K, U, L are phonemes. These help us in understanding. Feature analysis and feature combination processes seem to underline speech perception much as they do visual recognition. As with individual letters, individual phonemes can be analyzed as consisting of a number of features. These are given below.

1. Voicing

It is feature or sound of phonemes produced by the vibration of the vocal cords. Like,

Sip and zip

[s] is voiceless
[z] is voiced
Place your fingers as you produce each sound

2. Place of articulation

It refers to the place at which the vocal track is closed or constricted in the production of a phoneme. It is closed at some point in the utterance of most consonants.

Consonant pronounced using both lips;

A consonant pronounced by bringing both lips into contact with each other or by rounding them. In English the **bilabials** are b, p, m. and w.

f and v are labiodentals because the bottom lip is pressed against the front teeth.

t, d, s, z, n, l are alveolar because the tongue presses against the alveolar ridge of the gums just behind the upper front teeth.

Experiment

Miller & Nicely (1955) presented consonants in noise

	Voiced	Voiceless
Bilabial	[b]	[p]
Alveolar	[d]	[t]

b is voiced and p is voiceless. d and t are identical in case of articulation. They presented letters with noise.

Results

Subjects exhibited confusion and reported hearing one sound when actually another sound had been presented

Experimenters were interested in which sound was confused with which

Feature analysis model would predict more confusion with sounds that differed by only a single feature.

When presented with [p], subjects more often thought that they heard [t] than that they heard [d]. The phoneme [t] differs from [p] only in terms of place of articulation, whereas the [d] differs in both place of articulation and voicing. Similarly subjects presented with [b] more often thought they heard [p] than [t].

Lesson 16

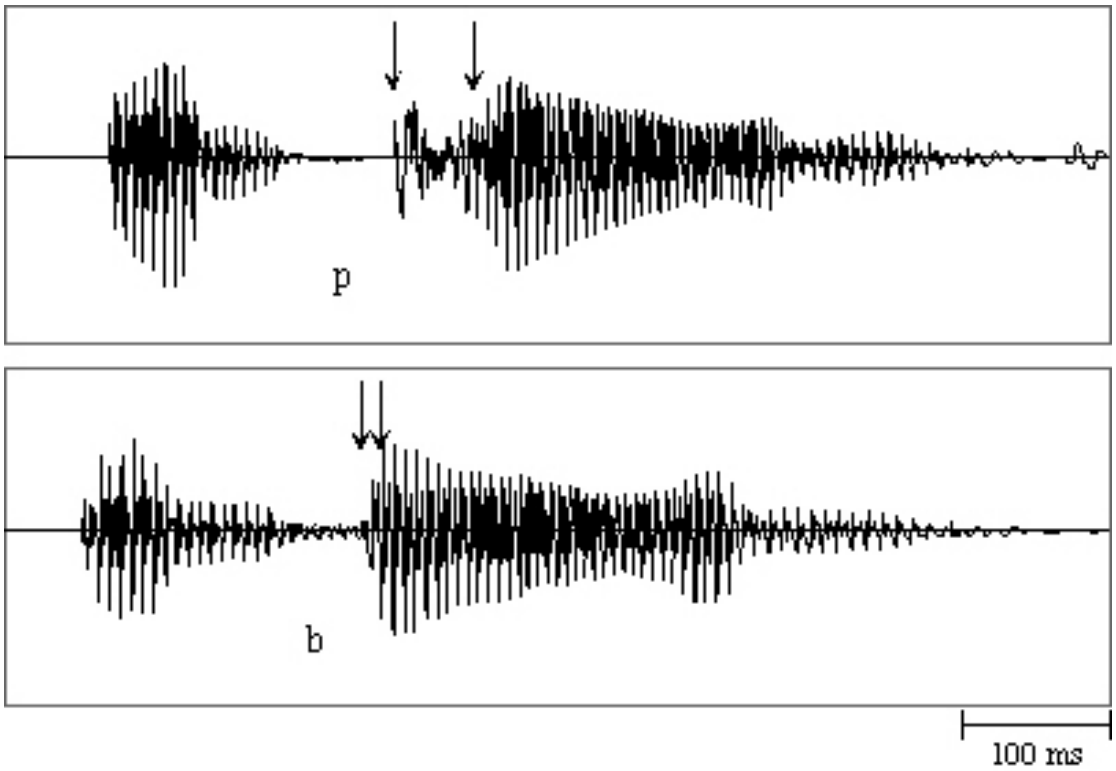
PATTERN RECOGNITION (continued)

Voice-Onset Time

Voice is human sound and onset means beginning. In the pronunciation of such consonants as [b] and [p], two things happen: Closed lips are opened, releasing air and the vocal cords begin vibrating (voicing). In voiced consonants such as [b], the release of air and voicing is nearly simultaneous. In unvoiced consonants such as [p], the release occurs 60 ms before the vibration begins. What we are detecting when we perceive a voiced consonant versus an unvoiced consonant is the presence or absence of a 60 ms interval between release and voicing. This period of time is called Voice-Onset Time.

And when release and voicing come at the same time then it is called voiced sound like ba.

An experiment was conducted to identify the voice-onset time. They presented two words anbil and anpil. They wanted to know the voice timing difference between b and p. The diagram is showing results. In Sound wave the first arrow is showing release. Second arrow is showing voicing. And the difference is 60 ms. P has long interval between release and voicing and b has short interval.



Adaptation paradigm

Eimas & Corbit (1973) conducted an experiment that called adaptation paradigm. When we listen a sound again and again we expect this sound will not come again. This is called the fatigue paradigm or adaptation paradigm.

Eimas and Corbit had their subjects listen to repeated presentations of da (voiced). This sound involves a voiced consonant, [d]. They then presented objects with a series of artificial sounds that spanned the acoustic continuum such as that between ba (voiced) and pa (voiceless). Subjects had to indicate whether each of these artificial stimuli sounded more like ba or more pa. They found that subjects who under normal conditions would report ba as ba were now reporting it as pa. They

found that subjects who under normal conditions would report ba as ba were now reporting it as pa. They reasoned that repeated voicing makes the perceptual system adapt to voicing and expect unvoiced stimuli. This experiment is very important because it tells us not the sound but itself features are being detected. That is a critical thing about the series of experiment.

Basic features of feature analysis model;

Cognitive psychology is trying to find the causes of these types of mistakes. Because usually behind these mistakes, is a theory or model.

Whenever we can not see the problems we can not find the weakness of systems. So we can not explain any system without understanding its process.

In model of hearing we talk about template matching. There are thousands of sounds in the world. Like different sounds make by tonga wala have meanings in other languages. Sounds are different in different languages. A small feature can change all meanings of sentence or words. Some words vary with tone.

Cognitive psychology is not just about laboratory experiments. It is about our daily life. Speech recognition is also related with its features.

Lesson 17

PATTERN RECOGNITION (continued)

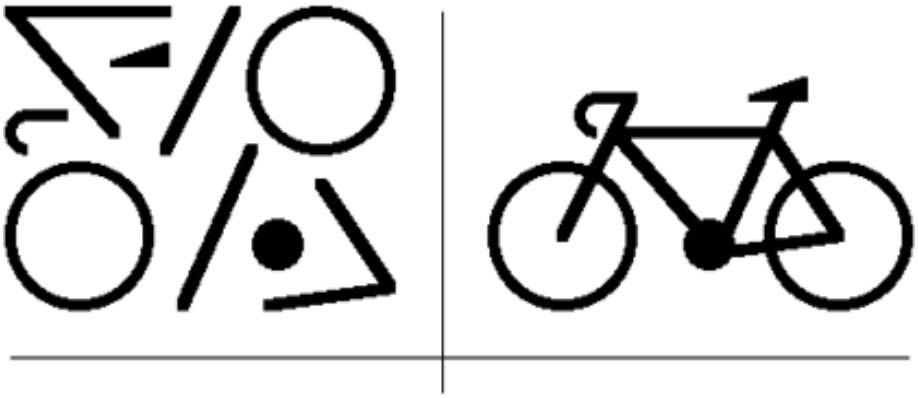
Gestalt Theory of Perception

Pattern recognition is constructing a new thing.

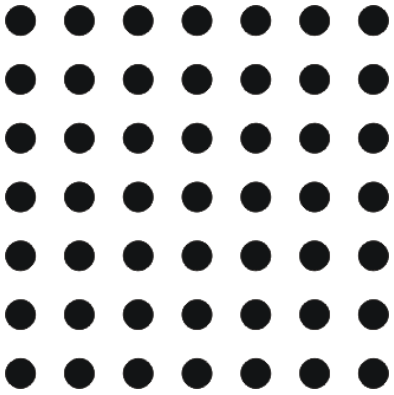
Various principles determine how we segment an object into components. Only after the segmentation does perceptual pattern matching come into play. Ideas for aggregating various lines and images into segments are very similar to what have been referred to as gestalt principles of perceptual organization. Gestalt is a new concept presented by German Psychologist in the 20th century.

In the following diagram, on the right side there are different figures and shapes. And on the left side these shapes and figures are arranged in bicycle shape. All infrastructures is scattered in left side but on the other side these all are arranged in unified whole (pattern) and giving meanings. We see things as whole.

The unified whole is different from the sum of the parts.

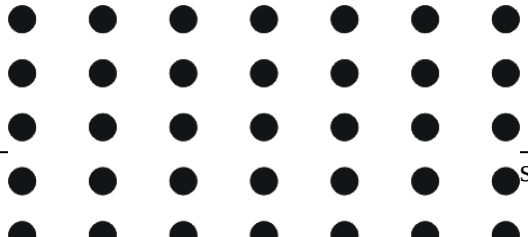


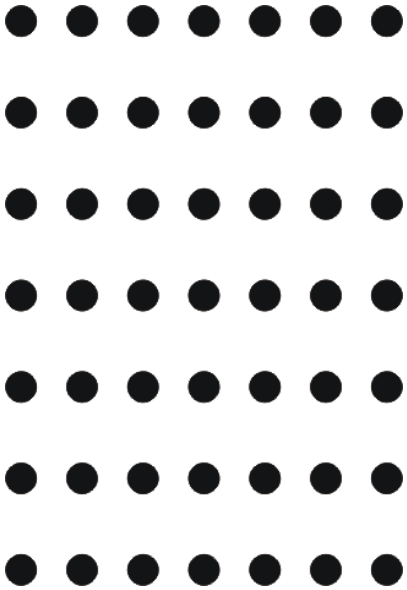
How are these circles organized?



Some see rows and some see columns.

How about now?





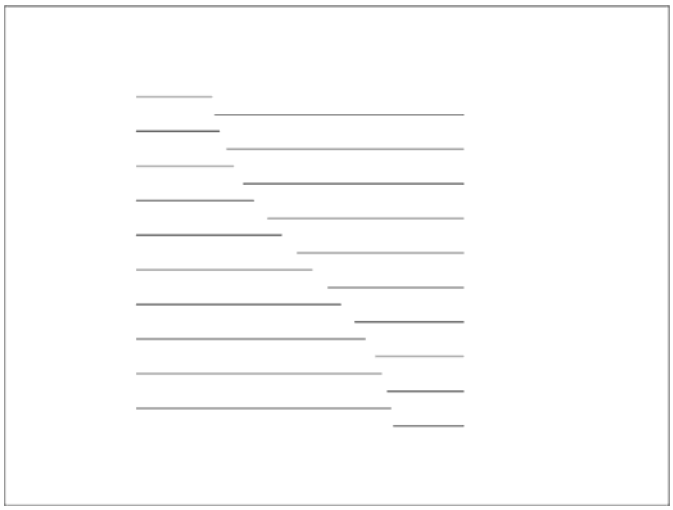
Number of circles remains the same but in slightly different shape or organization. We see it differently than previous diagram. Same number of circles is presented in different dimensions. People see them differently.

In all the key word is organization.

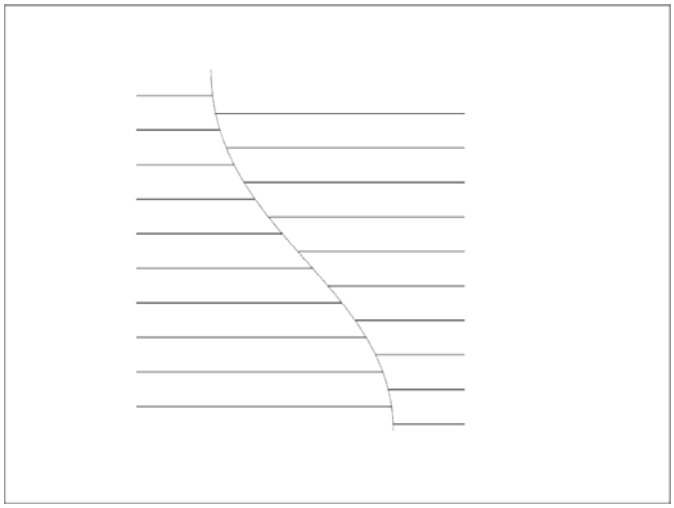
What do you see?

What is u seeing in this picture? Some see it as a picture of young lady some see it as picture of old lady. How one thing is different for different people? That is just because of different perceptual organization. The principle of gestalt is how we organize information and interpret it.

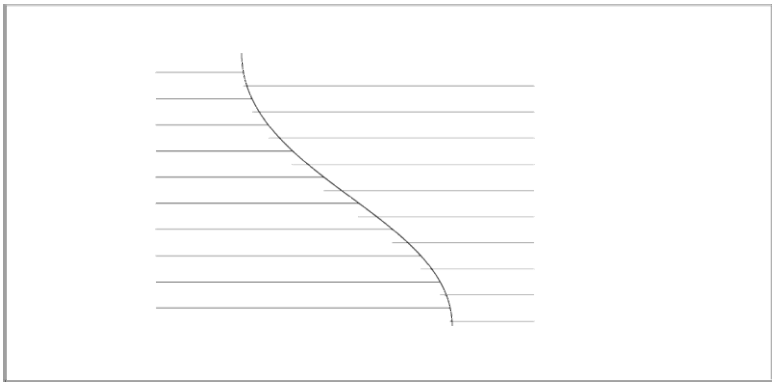
Look into this diagram



Some look it as it is a pattern that has broken into two parts. But some people perceive it as these are two kinds of lines short and long. Some see a boundary between lines.



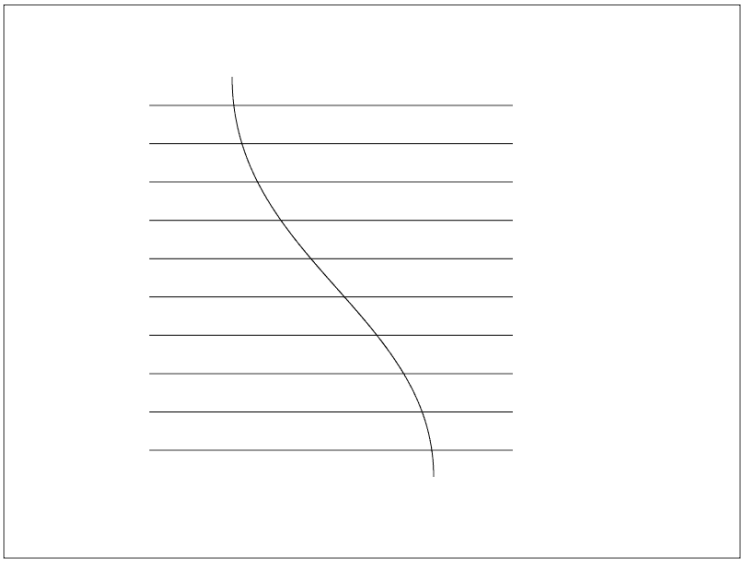
In this diagram the line is drawn between lines. That is representing a boundary.

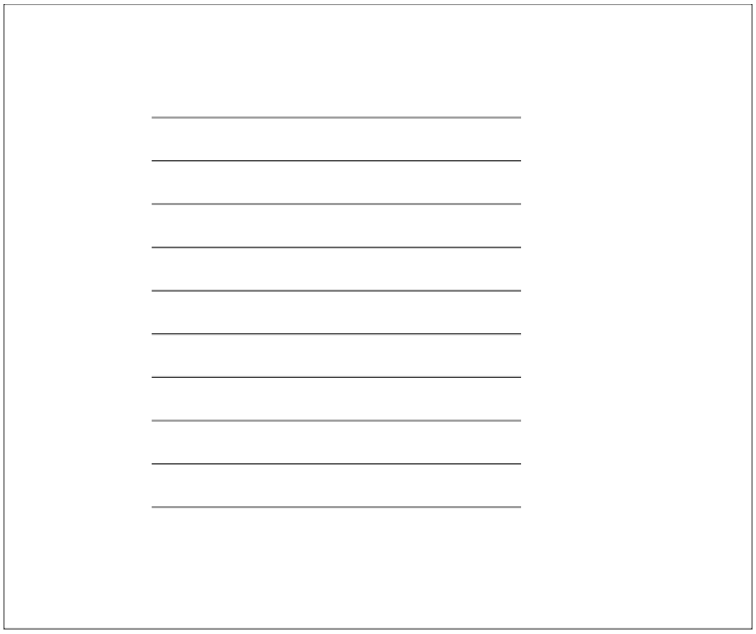


In this diagram the dimension is changed through shading and shifting of position. That is showing these are different patterns. This line and pattern is converted the concept of one pattern into a concept that these are two different patterns. And we say someone made this pattern wrong.

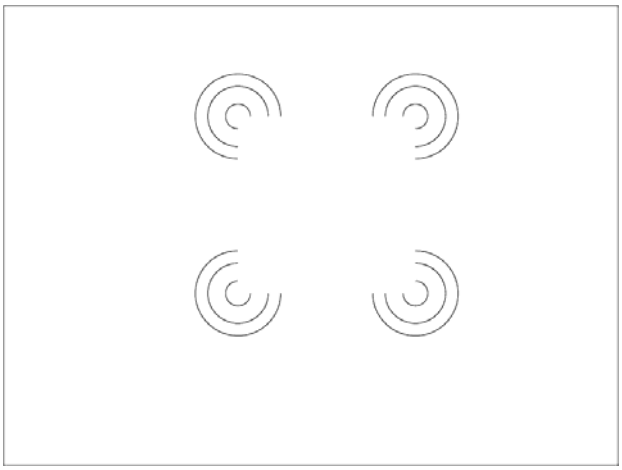
The purpose of all these diagrams is that how a little difference in same things can be viewed differently. In all diagrams parts are same but their organization is different, this slight difference in organization changes our all visual perception. A slight difference cause huge perceptual difference.

The central idea of gestalt principles is the unified whole is different from the sum of its parts.

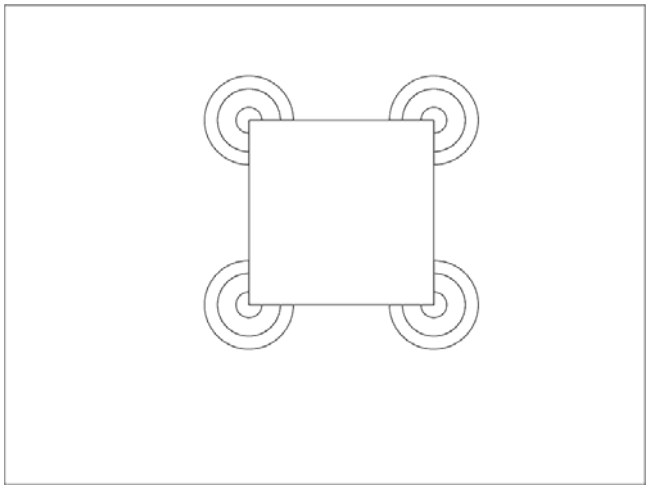




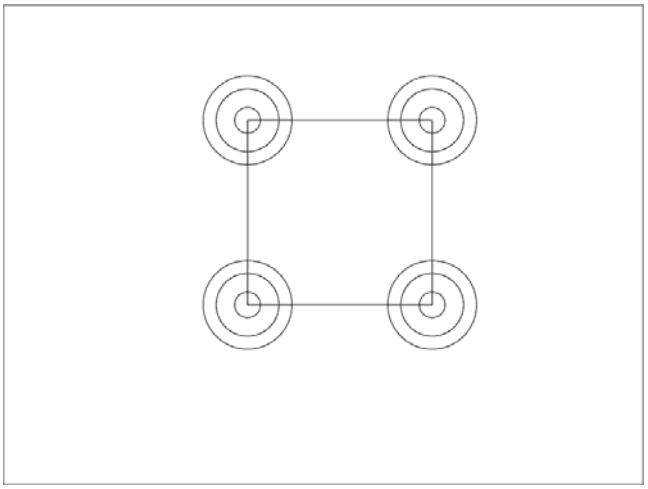
These two diagrams are showing same lines but with a slight difference of line. So our perceptual system perceives them differently.



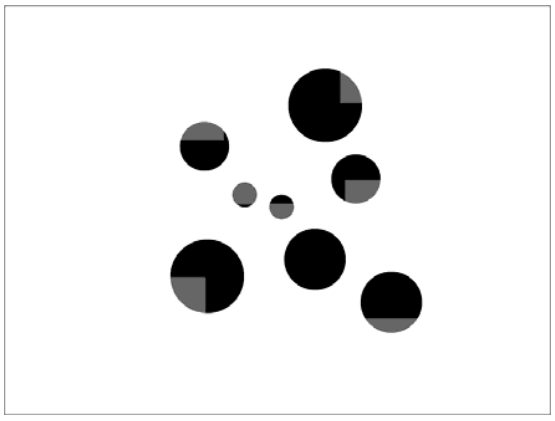
We perceive four different patterns of circles in above diagram. We all also see a square in the middle of circles. Even there is no square but we perceive.



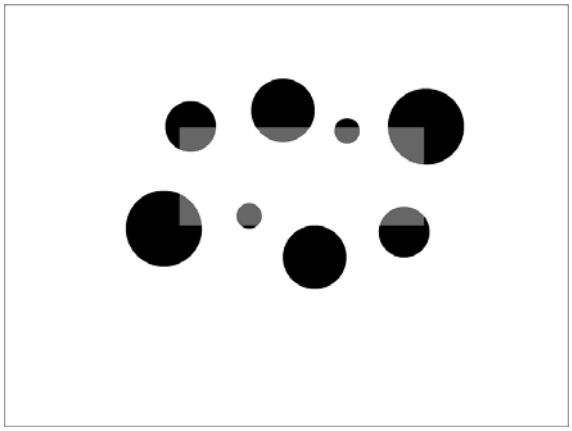
In this diagram where we perceived a square there is exactly a square but we are also showing four circles behind the square. But in reality these are not circles these are curves. This is a significant prove of Gestalt theory. Mind usually doesn't like to see things incomplete. We tend complete figures that are incomplete and mind sees it. We don't do it consciously.



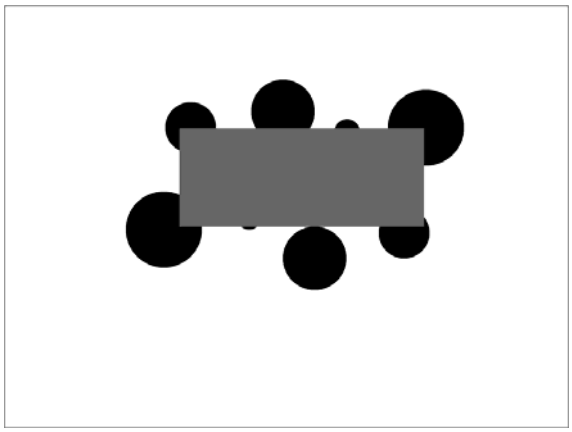
Look at this figure you are seeing black circles with grey shading in few circles.



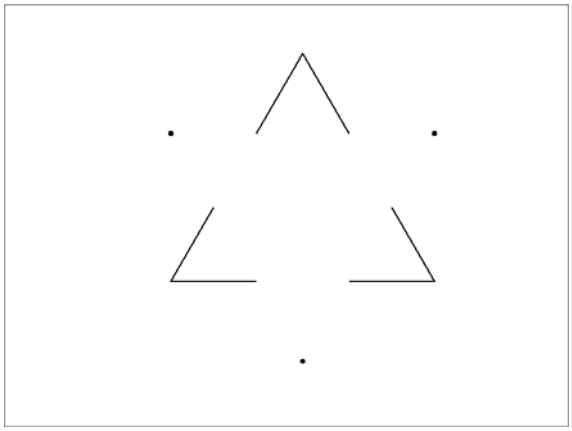
But in following figure the circles are arranged in such a way in which grey shading making an imaginary rectangle.



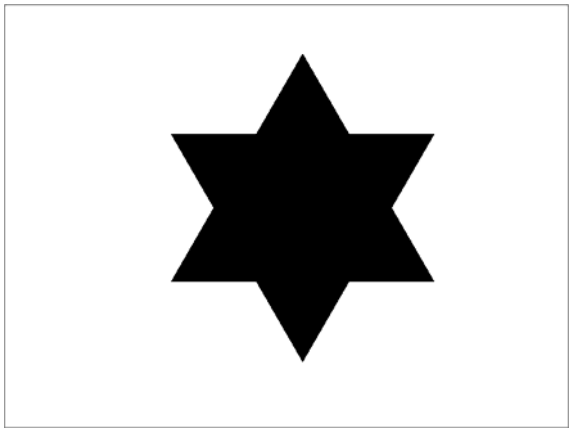
In this figure the rectangle has shaded dark. We perceive this figure as 8 circles and one rectangle. But in real there is only one complete circle that is at bottom.



This all means we see something else our visual information receive incomplete information but our mind tend to complete it.



In this figure we can perceive it as six pointed star. In real we are seeing an incomplete triangle



and three dots. But we are used to see star.

In this figure of real star we can see two rectangles as well.

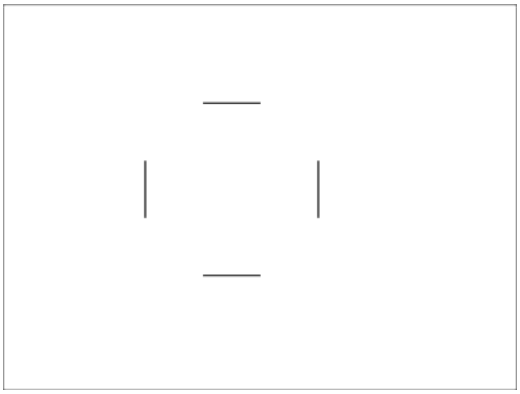
Lesson 18

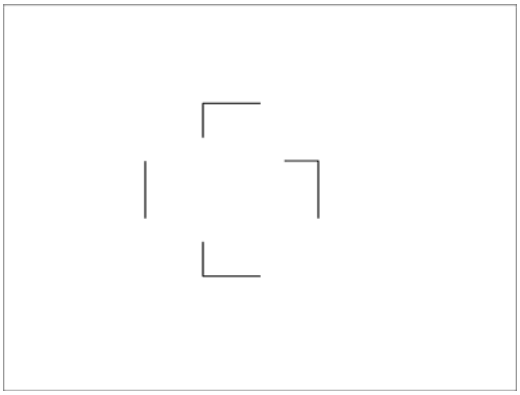
PATTERN RECOGNITION (continued)

Gestalt Theory of Perception

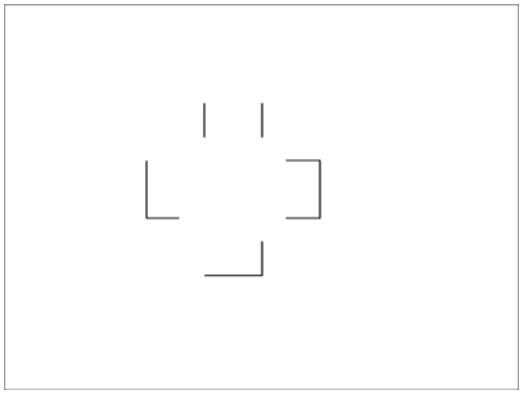
Gestalt principles are basically principles of perception.

This figure is consisted on four lines two are horizontal and two are vertical. But some people may be perceived it like a cross.

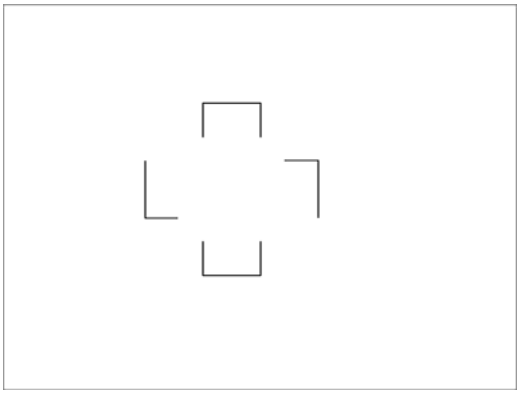




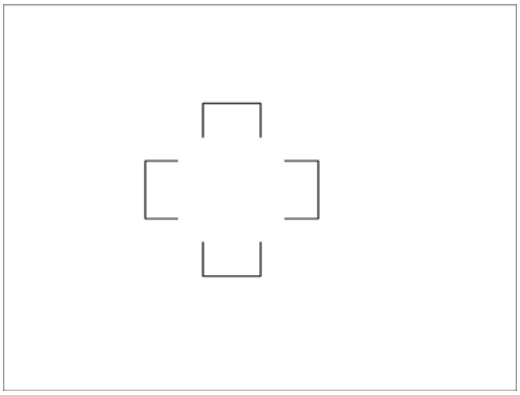
People perceive these figures differently.



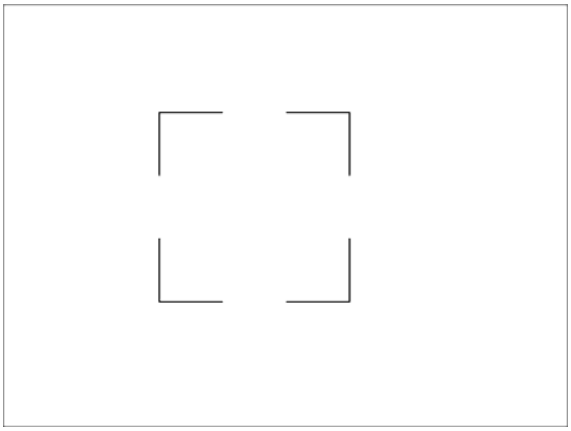
There are more chances this figure is perceived as cross.



This following pattern may be perceived as square. Some can also perceive it as cross.



So, it is human tendency to complete the figure even some information is missing.



People perceive it as square even lines are not completed.

Gestalt principles of Organization

Most common principles of gestalt theory are;

Proximity

The law of proximity says that items which are close together in space or time tend to be perceived as belonging together or forming an organized group.

Similarity

This law says that same things are considered one thing. Similar items tend to be organized together.

Good continuation

The tendency to perceive a line that starts in one way as continuation in the same way.

Closure

It refers to perceptual processes that organize the perceived world by filling in gaps in stimulation.

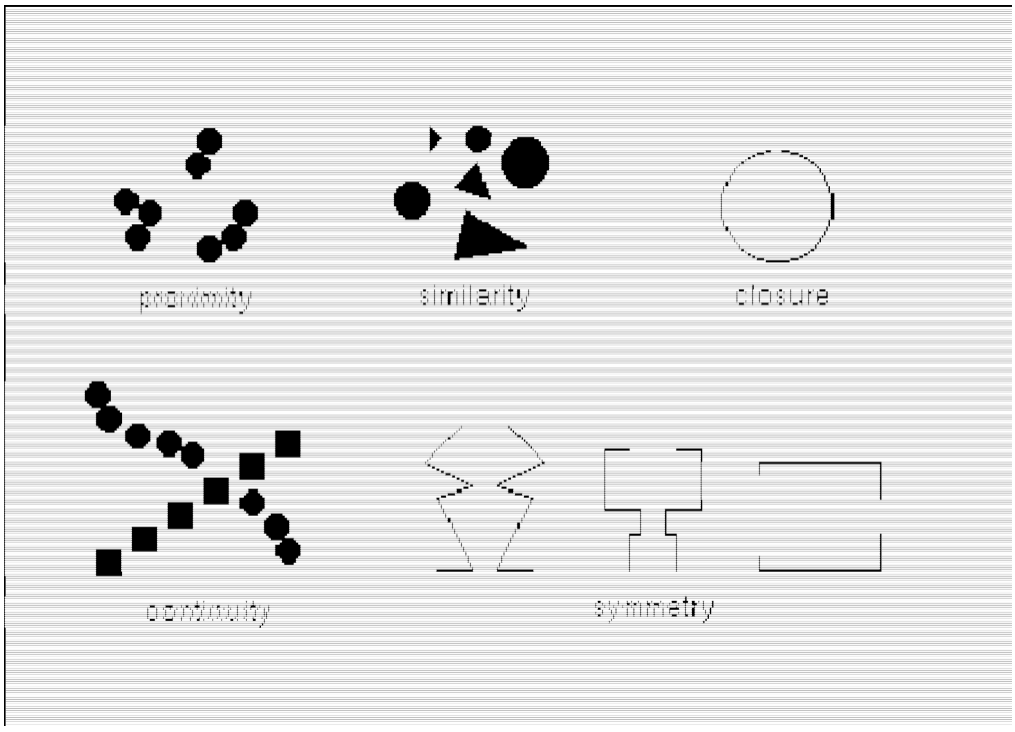
Good Form

It is a type of closure. We fill in the gaps perceive form rather than disconnected lines.

Symmetry

It says that there is a tendency to organize things to make a balanced or symmetrical figure that includes all the parts.

Some more examples



These are examples of gestalt principles.

Queen Elizabeth's vase

It is a gift that was given to the Queen Elizabeth on her silver jubilee. It is a vase but we perceive it as a figure of two faces. We change background in figure and figure into background. Figure and background is very important concept in Gestalt theory. This is crucial concept in visual perception.

Palmer (1977)

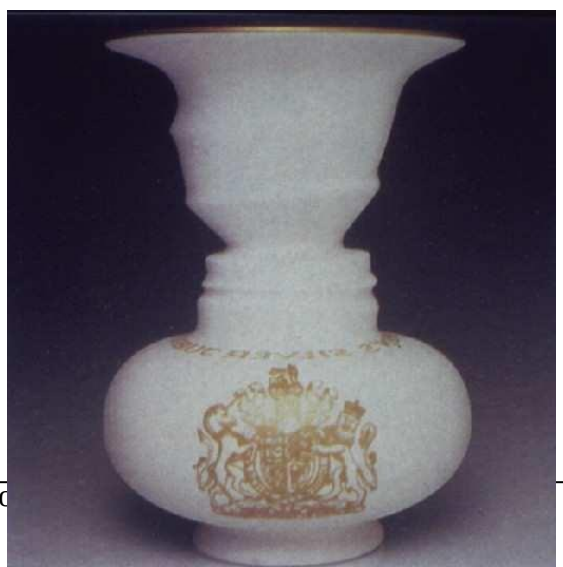
Palmer (1977) studied subjects' recognition of figures such as the ones in following figure. He first showed subjects stimuli such as (a) and then asked them to decide whether fragments (b)-(e) were part of the original figure. Stimuli (a) tends to organize itself into a triangle and a bent letter n. Palmer found that subjects could recognize the parts most rapidly when they were the segments predicted by the Gestalt principles. Thus we see that recognition depends critically on the initial segmentation of the figure. The figure is;

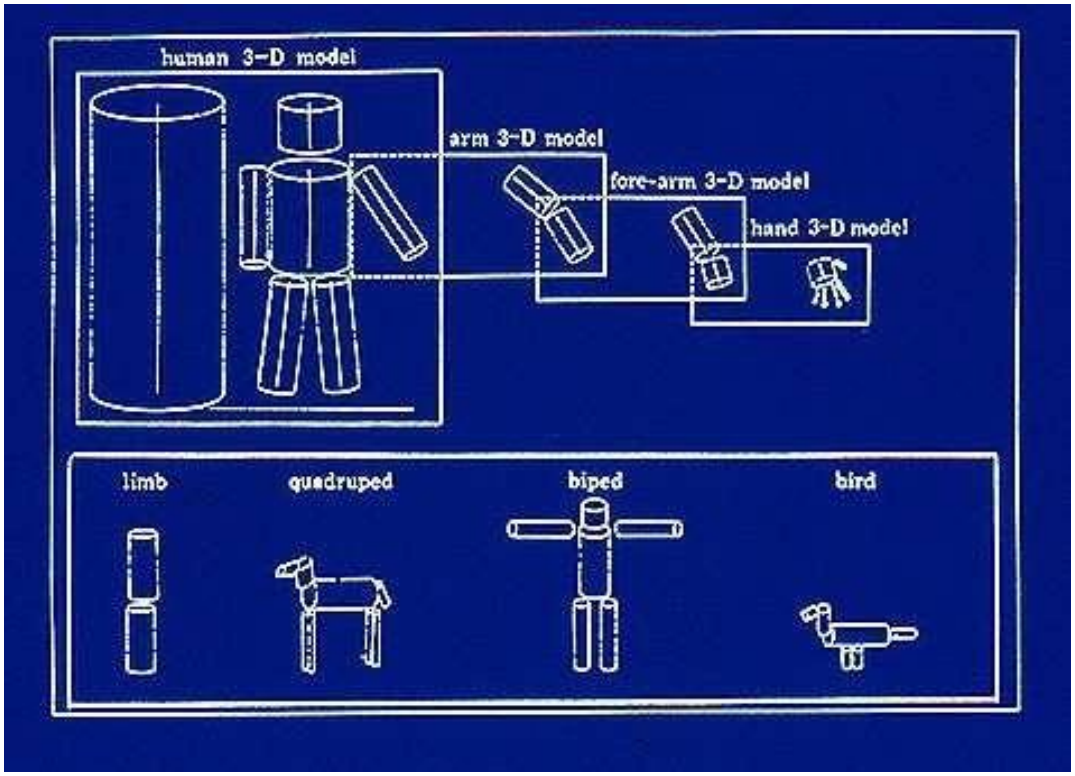
FIGURE 2.11: Examples of stimuli used by Palmer (1977) for studying segmentation of novel figures: (a) the original stimulus that subjects saw; (b to e) the subparts of the stimulus presented for recognition. Stimuli shown in (b and c) display good subparts; (d and e) give bad subparts.

Object Perception

The basic idea is that a familiar object can be seen as a known configuration of simple components.

Marr & Nishihara (1978) purposed that familiar objects can be seen as configuration of simple pipe-like components. For instance, in the following figure the human model is presented. Different types and sizes of cylinders make a human model. We perceive these cylinders as human model. The diagram of bird is also consisted on cylinders. Different sizes, types and shapes of cylinders are used to make different diagrams. It is a Computer model.





Another contribution was made by Biederman in 1987.

Biederman (1987) has proposed that there are three stages in recognition of an object as a configuration of simpler components.

1. Segmentation into sub-objects
2. Classify the category of each sub-object
3. Recognition as a pattern made of sub-objects

Lesson 19

OBJECT PERCEPTION (continued)

Biederman (1987) proposed three stages in recognition of an object as a configuration of simpler components

Segmentation into sub-objects

Classify the category of each sub-object

Recognition as a pattern made of sub-objects

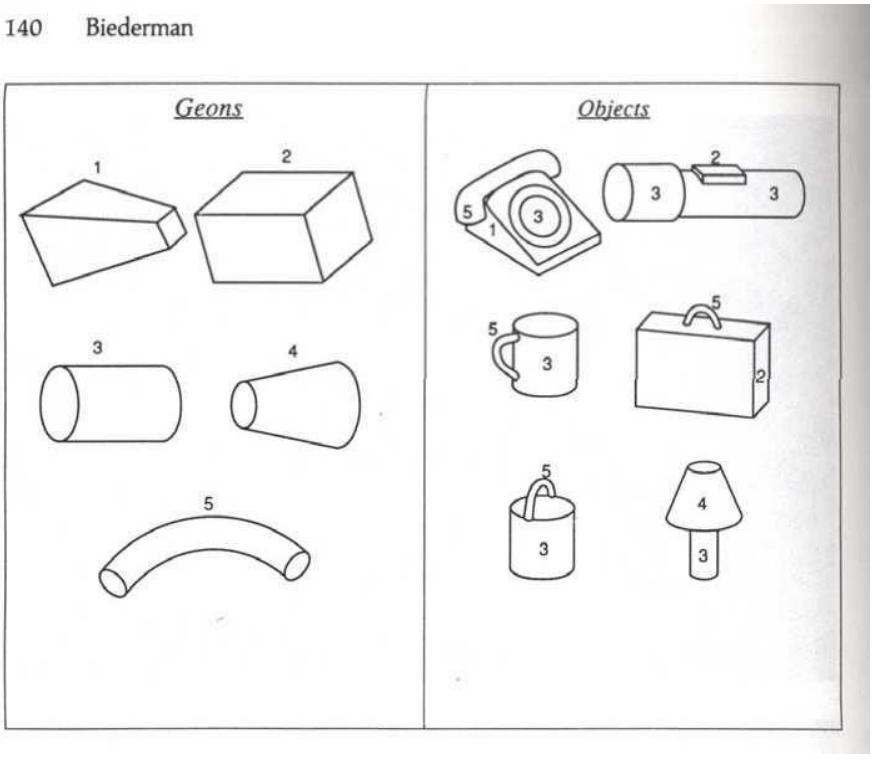
1. Segmentation

Sub-objects are defined by their line contours – Edge and bar detectors from David Marr. Hoffman and Richards (1985) – Gestalt principles can be used to segment an outline representation of an object into sub-objects. They observe that where one segment joins another there is typically a concavity in the line outline.

2. Classification of sub-object categories

Second, once an object has been segmented into basic sub-objects, one can classify the category of each sub-object. Biederman (1987) argues that there are 36 basic categories of sub-objects, which he calls Geons which is abbreviation of geometric ions.

The five geons are showed in following figure. There are geons that are making different objects. Like number 1 geon is a part of telephone. And geon number 5 is a receiver of telephone set. He uses geons to explain the objects. He says we can vary the size of the shape and get different objects. Same type of geons makes different things of different organization. Altogether Biederman proposes there are 36 geons that can be generated in this manner and that they serve as an alphabet for composing objects, much as letters or phonemes serve as the alphabet for building



up words.

3. Recognition of object

Third, having identified the pieces out of which the object is composed and their configuration, one recognizes the object as the pattern composed from these sub-objects or pieces. Thus, recognizing an object is like recognizing a letter; the sub-objects become the features.

Minor details and variations don't matter. As in the case of letter recognition there are many small variations on the underlying features geons that should not be critical for recognition. Edges are more important than texture to define geons. Color, texture, and small detail should not matter. This predicts that schematic line drawings of complex objects which allow the basic geons to be identified should be recognized as quickly as detailed color photographs of the objects.

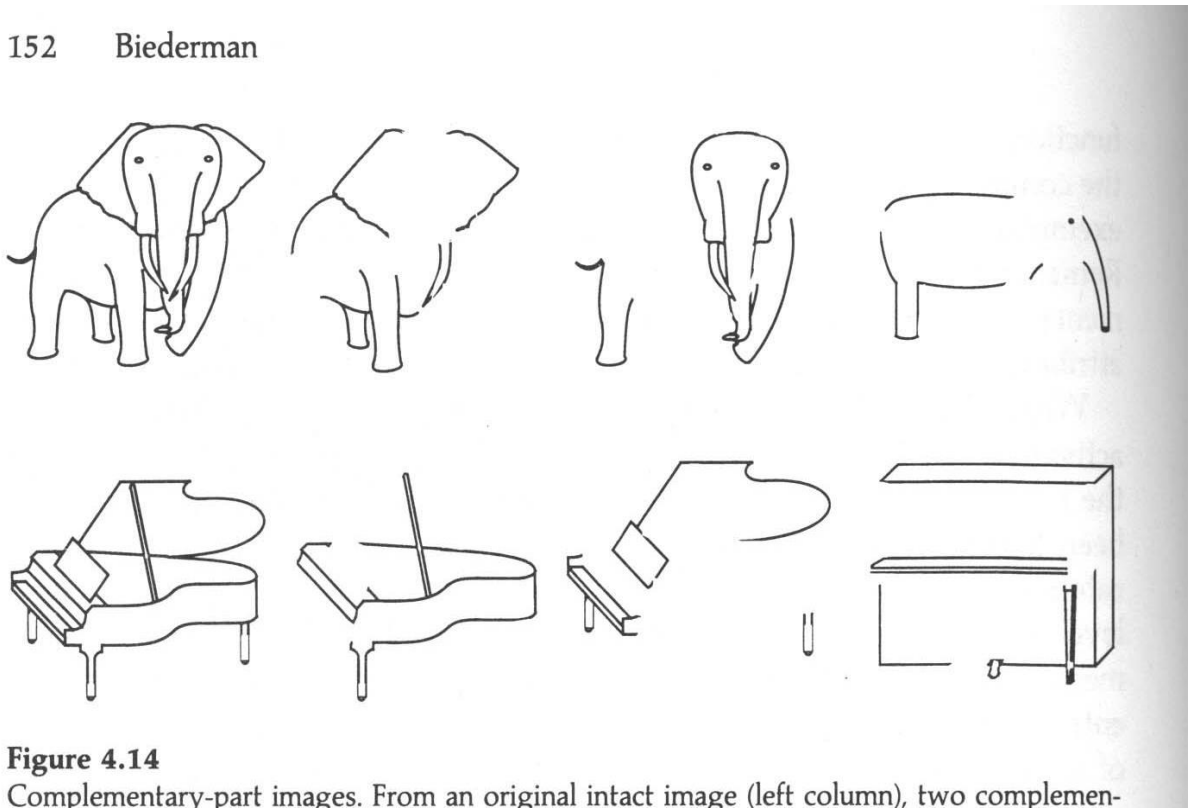


Figure 4.14
Complementary-part images. From an original intact image (left column), two complemen-

Biederman conducted an experiment to test his hypothesis. He showed different shapes to subjects. They created two conditions.

Segment deletion

Component deletion

In that experiment some objects had whole components deleted while others had all the components present but segments of these components were deleted. They presented these two types of degraded figures to subjects for various brief intervals and asked them to identify the objects.

Like in above figures, the components of elephants are separated and showed. In one figure the components were deleted.

Biederman's evidence

The critical assumption is that object recognition is mediated by recognition of the components of the object. The results showed, at very brief presentations (65-100 milliseconds) subjects were more accurate at the recognition of figures with component deletion than segment deletion. This reversed for the longer 200 milliseconds presentations. Biederman reasoned that at the very brief intervals subjects were not able to identify the components with segment deletion and so had difficulty in recognizing the objects. With 200 milliseconds exposure, however, sub-objects were able to recognize all the components in either condition. Since there were more components in the condition with segment deletion they had more information as to object identity.

So, we can conclude it that we do not split reality in geon or anything else. We bring all the information into our sensory store. There is difference between reality and representativeness, reality and perception, and reality and recognition.

Lesson 20

ATTENTION & PATTERN RECOGNITION

Attention is required to combine features to perceive patterns.

Treisman & Gelade (1980) performed an experiment. They had the subjects try to detect a T in an array of 30 I's and Y's. They reasoned that subjects could do this by simply looking for the cross-bar feature of the T that distinguishes it from all I's and Y's. Subjects took about 800 milliseconds to make this decision. Triesman and Gelade also asked subjects to detect T in an array of 30 I's and Z's. In this condition, they could not use just the vertical bar or just the horizontal bar of the T; they could have to look for the conjunction of these features, performing the feature combination required in pattern recognition. It took subjects more than 1200 milliseconds to make their decision. Thus, a condition requiring them to recognize the conjunction of features took about 400 milliseconds longer than one in which perception of a single feature was sufficient. Triesman and Gelade varied the size of the display they found that subjects were much more affected by display size in the condition that required recognition of the conjunction of features. Subjects showed little difference between the single feature and the conjunction condition for displays containing fewer than five letters. Only with displays presenting more distracters did subjects' attention become substantially overload. It might seem surprising that attention is required to detect patterns of features that define common letters. We have experience of automatically recognizing letters. For familiar letters the deficit in perception of feature conjunctions only becomes apparent with large displays.

Attention is not just orientation.

Context & Pattern Recognition

Look at the top line you see a hen, a rabbit, after the rabbit there is dog and cat. After that there is an animal even it is not clear. In bottom line you can see a picture of man, woman, child and girl. We perceive the last picture as a picture of human. Even this picture is same like the above picture. Because of the context we perceive things. Same picture when is included in animals picture we perceive it as animal and when this is in human pictures we perceive it as human.

Figure 1.6 Example of the same pattern recognized as two different objects. (From "The Role of Frequency in Developing Perceptual Sets" by B. R. Bugelski and D. A. Alampay, *Canadian Journal of Psychology*, 1961, 15, 205–211. Copyright 1961 by the Canadian Psychological Association. Used by permission.

Top-Down Processing

The general context provided by the words forces the appropriate interpretation. When context or general world knowledge guides perception, we refer the processing as top- down processing, because high-level general knowledge determines the interpretation of the low-level perceptual units.

THE CAT

The middle letter can be seen as A or H.

Top Down Processing or contextual effects. It means surrounding has effect on our perception.

Word Superiority Effect

This phenomenon can be understood by the experiment of Reicher and Wheeler (1970).they presented a brief presentation of either a letter (D) or a word (WORD). Immediately afterward they were given a pair of alternatives and instructed to report which they had seen. If they had been showed D, subjects might be presented with D or K as alternatives. If they had been shown WORD, they might be given WORd, or WORK as alternatives.Subjects showed a letter alone or in a word. Subjects were about 10% better in word condition. They more accurately discriminated between D and K in the context of word than as letters alone. This phenomenon is called word superiority effect (WSE).

Why WSE?

Rumelhart & Siple (1974) has provided one explanation for Why subjects are more accurate in the word condition. Suppose subjects are able to identify the first three letters as WOR. Now consider how many four-letters words are consistent with a WOR beginning WORK, WORD, WORM, WORN, WORT

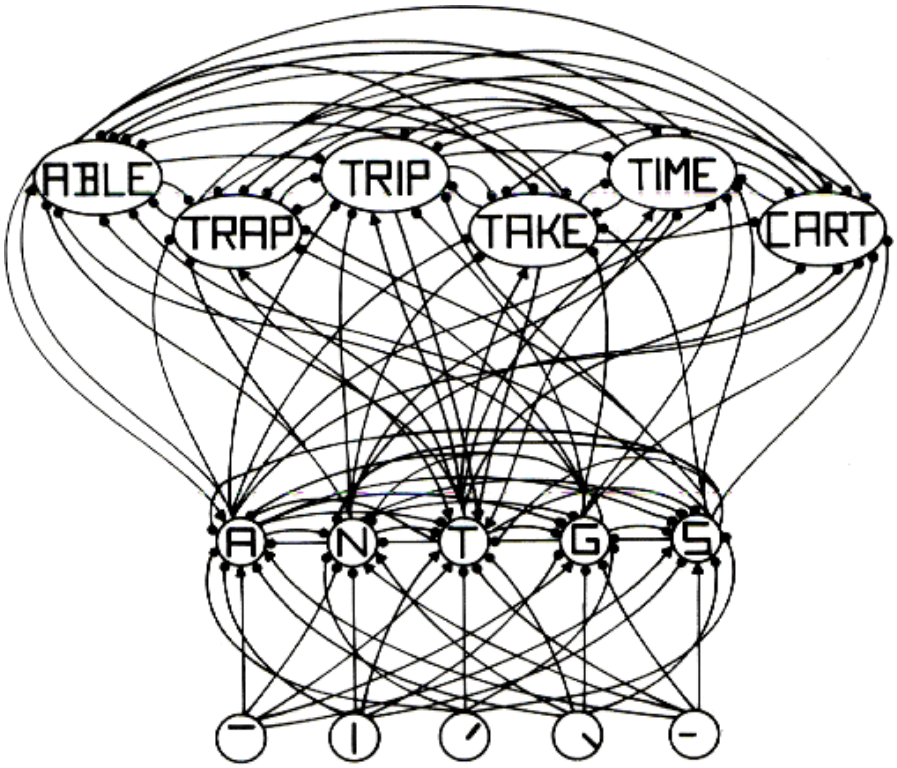
Suppose subjects only detect the bottom curve in the fourth letter. However, when the letter is presented alone and subjects detect the curve, they will not know whether the letter was B, D, O, or Q, since each of these letters is consistent with the curve feature. Thus, in WOR context subjects need only detect one feature in order to perceive the fourth letter, but when the letter is presented alone they must identify a number of features. Their analysis implies that Perception is inferential. Like curve in D will help in recognition

Lesson 21

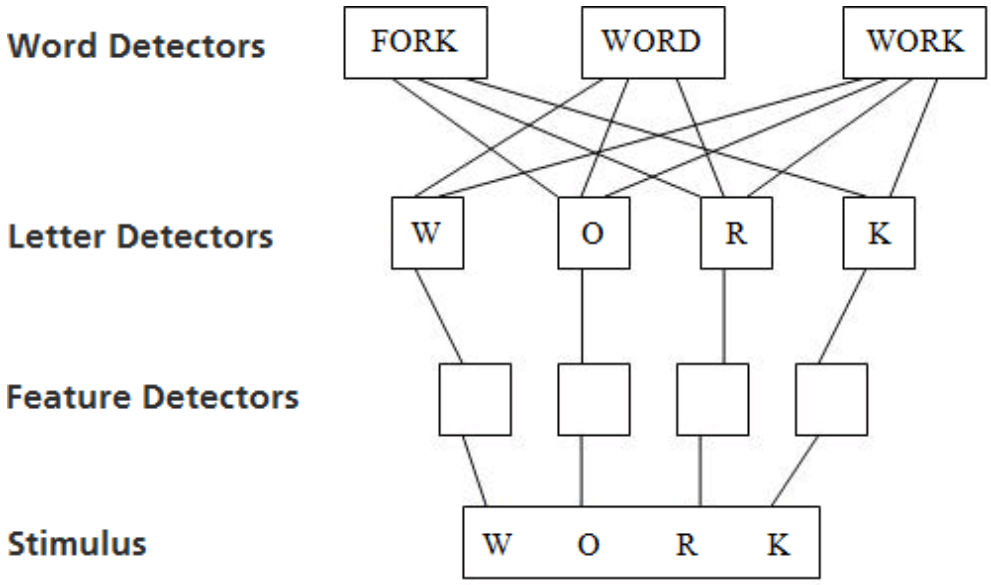
PATTERN RECOGNITION (CONTINUED)

Neural Networks

This model is also called PDP's or Parallel Distributed Processing. McClelland and Rumelhart (1981) made a pattern recognition network. It solves the paradox of bottom-up versus top-down. McClelland and Rumelhart implemented this network to model our use of word structure to facilitate recognition of individual letters. In this model, individual features are combined to form letters and individual letters are combined to form words. This is connectionist model. It depends heavily on excitatory and inhibitory activation process. Activation spreads from the features to excite the letters and form the letters to excite the words. Alternative letters and words inhibit each other. Activation can also spread down from the words to excite the component letters. In this way a word can support the activation of a letter and hence promote its recognition. In such a system, activation will tend to accumulate at one word and it will repress the activations of other words through inhibition. The dominant word will support the activation of its component letters, and these letters will repress the activation of alternatives letters. The word superiority effect is due to the support a word gives to its component letters. The computation proposed by McClelland and Rumelhart's interactive activation model is extremely complex, as is the computation of any model that stimulates neural processing. This process helps us in understanding how neural processing underlies pattern recognition. The figure of this model is given below.



This is the part of pattern-recognition network proposed by McClelland and Rumelhart to perform word recognition by performing calculation on neural activation values. Connections with arrowheads indicate excitatory connections from the source to the head. Connections with rounded heads indicate inhibitory connections from the source to the head. This net is making network.



This is simpler version of neural network. This diagram is showing a word WORK. At one level there is feature detector. Feature detectors are being not showed. At another level there are letter detectors. We recognize W because of features. O R and K are recognized. All words activate because of letters. Four words of WORK are activated. These three words are competitors in word recognition. WORK is recognizing by four letters. This is parallel distributor processing model. This is also called neural network model of pattern recognition model. This is called neural network because there is an abstract concept or quantity that called nodes.

Neural Networks

Neural networks is consisted on

- Nodes
- Links
  - Excitatory
  - Inhibitory
- Weights
- Learning consists of re-adjustment of weights

Nodes

Nodes are a set of processing units. Nodes should not be confused with neurons. Nodes are represented by features, letters and words in the interactive activation model. They can acquire different levels of activation. All boxes in above diagram are nodes. Lines are links. Nodes are connected through these lines.

Patterns of connections

Nodes are connected to each other by excitatory or inhibitory connections that differ in strength.

Another important concept is activation rules. These specify how a node combines its excitatory and inhibitory inputs with its current state of activation.

Excitatory connections

These are those connections that make other nodes active. Those nodes are connected with excitatory connections they are active or charged.

Inhibitory connections

Those connections that make other nodes relax and switch off.

Because of these connections the neural network exists.

State of Activation

Nodes can be activated to various degrees. We become conscious of nodes that are activated above a threshold level of conscious awareness. We become aware of letter K in the word WORK when it receives enough excitatory influences from feature and word levels.

A Learning Rule

Learning generally occurs by changing the weights of the excitatory and inhibitory connections between the nodes. The Learning rule specifies how to make these changes in the weights.

Initial weights

Re-adjustment of weights

PDP and learning

The Learning component is the most important feature of a neural network model because it enables the network to improve its performance. In a lab in California a computer learns how to speak by reading and re-reading simple English sentences – improving from its own mistakes.

PDP and its significance

Parallel processing models have improved computer functioning. That has made super computers. Super computers are called parallel computers. Multiple processors that communicate with each other work faster than serial processing computers. The paradoxes are resolved. Like forests are seen at the same time as the trees. Words are seen at the same time as the letters. Context helps in object perception; object perception helps in perception of context.

Lesson 22

PATTERN RECOGNITION (CONTINUED)

Effects of Sentence Context

Cognitive psychologist wants to study whether the sentence context has effect. In this order an experiment was conducted by Tulving, Mandler & Baumal in 1964.

Tulving, Mandler & Baumal (1964) conducted an experiment to show the effect at the multiword level. They used material in their experiment like

Countries in the United Nations form a military alliance.

The huge slum was filled with dirt and disorder.

Each sentence provides an eight-word context preceding a critical word. In various conditions subjects would see the following:

0 Context	disorder
4 Context	Filled with dirt and disorder
8 Context	The huge slum was filled with dirt and disorder

The critical word presented after the context for a very brief period. The experimenters manipulated the duration of this critical word from 0 to 140 milliseconds. They were interested in how bottom-up information interacted with context.

Results

Results were showing that the probability of a correct identification increases both as amount of context increases and as the exposure duration increases**.**

Conditions	flash duration	percentage of correct identification
0 context	0ms	0%
4 context	0ms	10%
8 context	0ms	16%
0 context	140ms	70%
4 context	140ms	80%
8 context	140ms	98%
0 context	60ms	30%
4 context	60ms	60%
8 context	60ms	70%

Maximum effect of context is seen at 60ms exposure, although the effect of context doesn't disappear at 140ms exposure. The effect diminishes somewhat between 60 and 140 milliseconds because subjects in the eight-word context condition are performing almost perfectly and show little benefit of further exposure, whereas subjects in the zero word condition continue to benefit from the longer exposure. The results indicate that subjects can take advantage of the context to improve their identification of the words.

Implications

That experiment shows that we can use sentence context to help identify words. With context we need to extract less information the word itself in order to identify it. We can use context to fill in words that didn't even occur.

We are able to fill in the missing from as we read the sentence, perhaps we did not even notice it was missing. PDP models can help explain this effect of context better than other models while also accounting for feature analysis.

Context and Speech

Text OK but does this work with speech. Speech is experienced sequentially in a more linear fashion than text.

A concept **Phoneme Restoration Effect** demonstrated in an experiment by Warren (1970). He had subjects listen to the sentence. The state governors met with their respective legislatures convening in the capital city. With a 120 ms pure tone replacing the middle *s* in *legislatures.* Only 1 in 20 subjects reported hearing the pure tone and even he wasn't able to locate it clearly.

Phoneme Restoration Effect

A nice extension of this first study is an experiment by Warren & Warren (1970). They presented subjects with sentences such as:

It was found that the eel was on the axle

It was found that the eel was on the shoe

It was found that the eel was on the orange

It was found that the eel was on the table

Wheel, heel, peel, meal

In each case, the denotes a phoneme replaced by non-speech. For the four sentences above, subjects reported hearing wheel, heel, peel, and meal, depending on the context.

Implications

The implications of this experiment are:

Context fills in gaps and affects our perception just as in texts.

The identification of the critical word is determined by what comes after the critical word. Heel, peel, meal and wheel are critical words.

Thus the identification of words can depend on the perception of subsequent words.

In a nutshell when you ever face a problem you should grasp the context. When you grasp the context you are able to understand and handle the problem.

Lesson 23

MEMORY

Short Term Working Memory

Memory that we use to function is called short term memory. Not the same thing as remembering what happened yesterday as opposed to a long time ago. Long Term Memory is an infinite storehouse. Short Term Memory is limited in capacity. Using the computer analogy, STM can be compared to RAM.

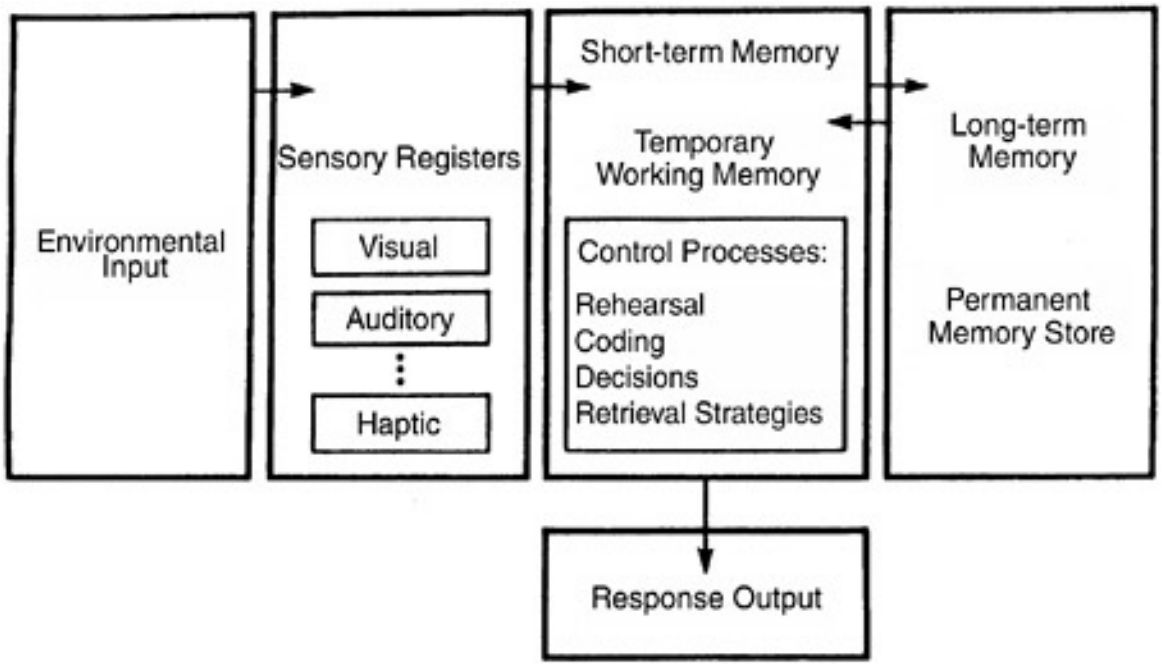
Attention is an integral part of short term memory. Attention is very important in short term working memory. Because we can not do any thing without paying attention. For instance if we are adding two numbers without attention we can not add them. Working memory is one of the most important topics of cognitive psychology along with attention. The memories that are currently active are often referred to as working memory because they are the knowledge which we can currently work with. Working memory pull out the information from our long term memory. Working memory also understand our information and input. But working memory does not do more works at the same time because Short Term Memory is limited in capacity.

Cognitive psychologists use the term short term memory for this kind of memory but some time use a term short term working memory. Working memory operates in the present moment. This is also called here and now.

Atkinson & Shiffrin Model

Atkinson and Shiffrin presented a memory model.

First of all the input comes in sensory register from environment. This information may be visual or auditory etc. then this input goes to short term memory. Arrows are showing this process.



Sometimes we listen a word that we have listened ago. It has been stored in our long term memory. Short term memory pull out information from long term memory and match this information with environmental input or information and then response out put.

In short term memory there are control processes. These processes happened in short term memory. These are rehearsal, coding, decisions and retrieval strategies.

Like when someone tells us telephone number we want to store it in our mobile. Until we do not store this number we rehearse the number in our mind. If we want to remember the information, for long term, we code the information in someway. We make decisions about information at our short term memory stage. Or short term memory makes decisions. The strategies of revision are also present in our short term memory. For example if we are shopping the things in market we make decisions to buy the things.

So the short term memory is very significant in our memory. We do all things in our short term memory. Our current information goes into long term memory and stored information in long term memory comes in short term memory. For example a depressive patient remind all his or her past life events that make him or her more depressive. So therapists help patient to forget old things. These old things are stored in long term memory.

Lesson 24

MEMORY

Short Term working memory (continued)

Short term working memory is a kind of memory that we use for functioning, for all our conscious awareness functioning. It is distinct from long term memory because it is not a store house of information. It keeps things for a very short time. An important model of short term working memory was given by Atkinson and Shiffrin.

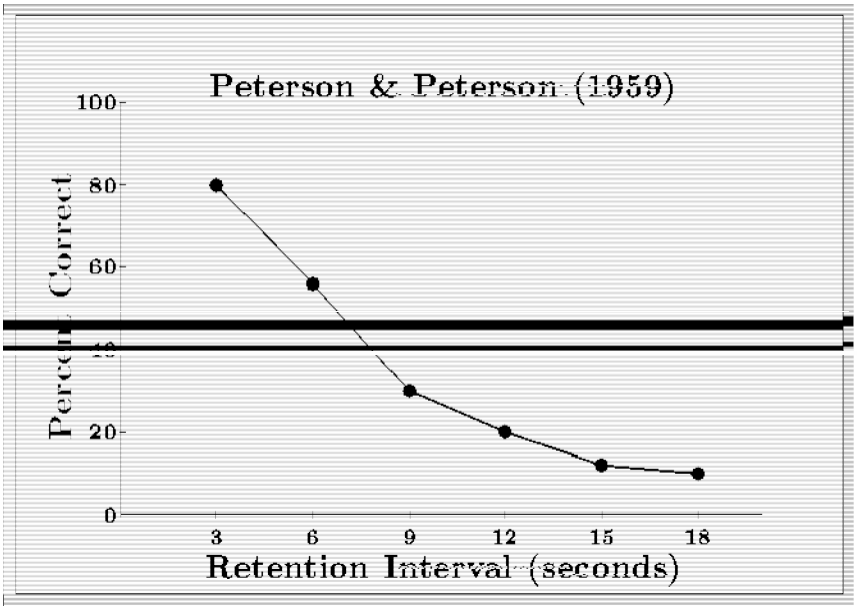
Rate of forgetting

Information in Short Term Memory is lost rapidly unless it is preserved through rehearsal. Perhaps the most characteristic feature about information in working memory is that if we do not do something special to keep it active, its activation will rapidly decay away and we will lose access to the information.

Peterson & Peterson (1959) conducted an experiment to illustrate the transient character of short term memory at Indiana University. They had subjects study three consonants (KCB) and then asked for recall of the letters after various

intervals of time up to 18 seconds. And then had subjects count backward by three during the retention interval. Thus, following presentation of the letters, subjects might be asked to count backward by threes as fast as possible from 506, 509, 512 and so on. They asked subjects count backward until the signal (light).

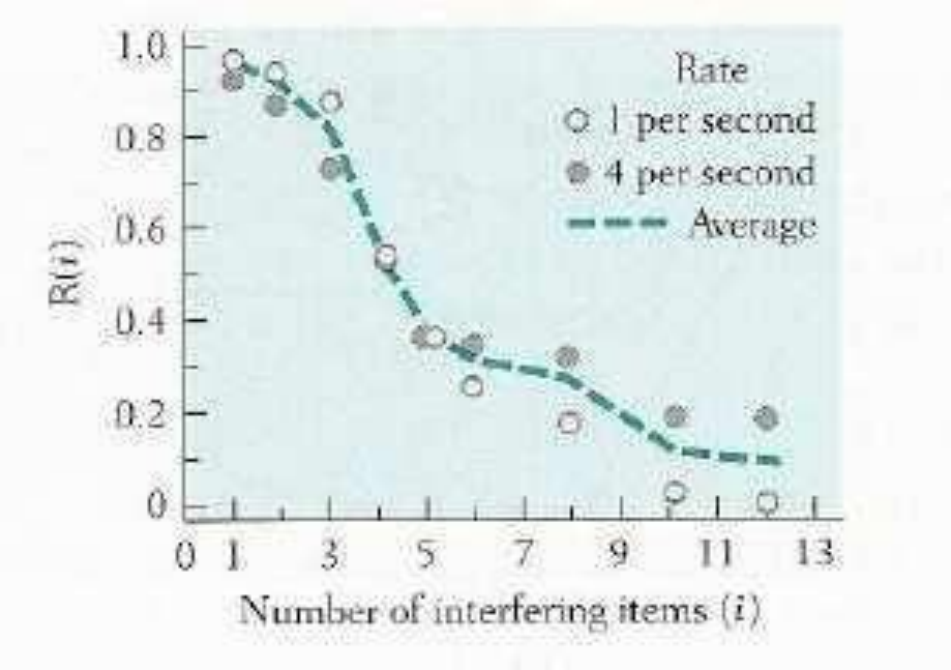
This diagram is showing the results. There is retention interval on X-axis and there is percent correct on y-axis.



Implications

Peterson and Peterson concluded. Information in STM decays very quickly. In 18 seconds subjects are performing at less than 20% accuracy level. But is it decay or interference?

For giving this answer of this question Waugh & Norman (1965) conducted a clever experiment. They said decay is due to interference. In their experiment they presented list of16 single digits. The last digit (probe) had occurred only once before in the list. The task was to report the letter after the probe. For example the list is …1, 2,7,6,8, 2 the correct answer = 7. Subject had to listen list and then reported what is the last number of last word. They varied the number of interfering items. They varied the rate as 1 digit or 4 digits per second. The purpose of varying the rate of presentation was that they thought when we vary the presentation then we can capture time factor.



This diagram is showing the results. There is number of items on X-axis and there is Rate on y-axis. Blank circles show the rate of presentation. One digit per second is showed by empty circles. Four digits per second are showed by black circle. The difference between black and white circles is not significant. But when we increase number of interfering items the decay is increasing. Because of interfering items the short term memory is becoming impaired. They concluded that loss of memory is due to interference of other task.

A practical experiment for student

Read digits 0-9 in a random order such as 7 3 4 9 6 8 2 to a friend.

Try reading lists ranging from five digits to 10 digits.

And then make a note of how many digits your friend can recall correctly.

Implications

Waugh & Norman (1965) concluded that it is difficult to maintain information in working memory. It has a limited capacity. Information decays quickly in working memory. If unattended the items in working memory will rapidly decay away in their level of activation.

Some people gave the idea that there are some slots in working memory. Working memories have a fixed number of slots?

What is the problem?

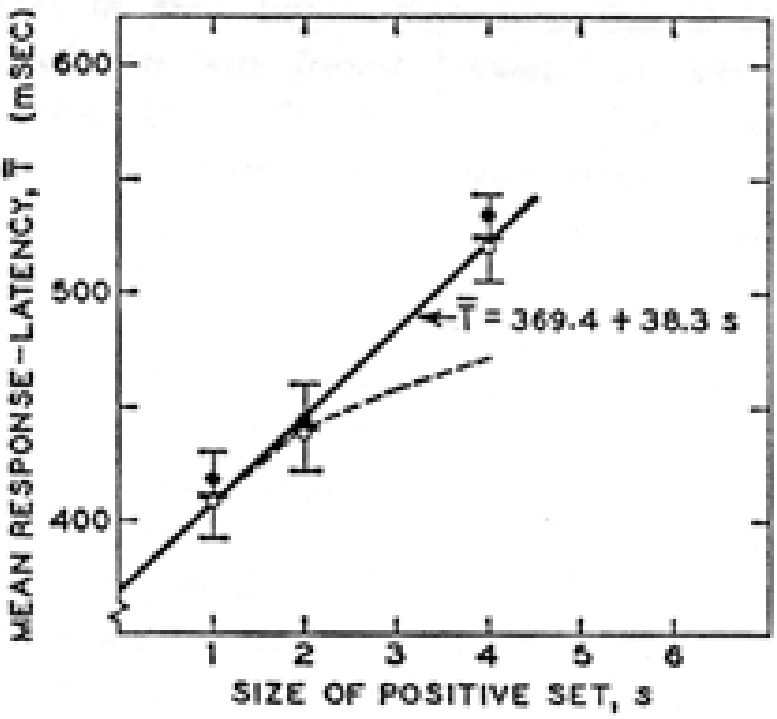
We are aware of many things in our environment at the same time**.** Fixed number of slots is not the issue. The problem is how to keep things that have disappeared active in the working memory. The problem is that information rapidly decays in its level of activation.

There are limitations on how many items one can maintain in working memory. Theses limitations are determined by how many items one can rehearse before they decay away.

Size of memory set

An experiment was conducted by Sternberg in 1969.

In his experiment he presented subjects with a memory set of digits (3, 4, 8, 1) to hold in short term memory. He then presented a test digit, and subjects were required to determine whether it was in the memory set. He varied the size of memory set from 1 digit to 6.



This figure is showing the result. There is a nearly linear relationship between memory-set size and judgment time. The size of memory set slows down judgment time whether the items are letters, words, colors, and so on, with all kinds of subject populations, and in all kinds of mental states.

Implications

Sternberg argues that subjects compare target letter with each letter in the set. The time taken by each comparison is 38ms.

His model was called Serial processing model.

Anderson proposes that target letter is compared with all the letters at the same time; the duration increases because the activation is spread across letters.

Working Memory: an activation model

The items in working memory are defined by a high level of activation, which enables reliable and rapid access to them. If unattended the items in working memory will rapidly decay away in their level of activation. One can maintain items in working memory by rehearsing them and keeping them in a highly active state. There are limitations on how many items one can rehearse before they decay.

Lesson 25

Memory

Short Term Working Memory

Short term memory and Working Memory are same. Some psychologists distinguish short term memory and working memory but majority of Psychologist Do not. Another important thing in memory is Attention. Attention plays an important and critical role in short term memory. Duration of short term memory is about 20 seconds. Working Memory is a memory that we use to function.

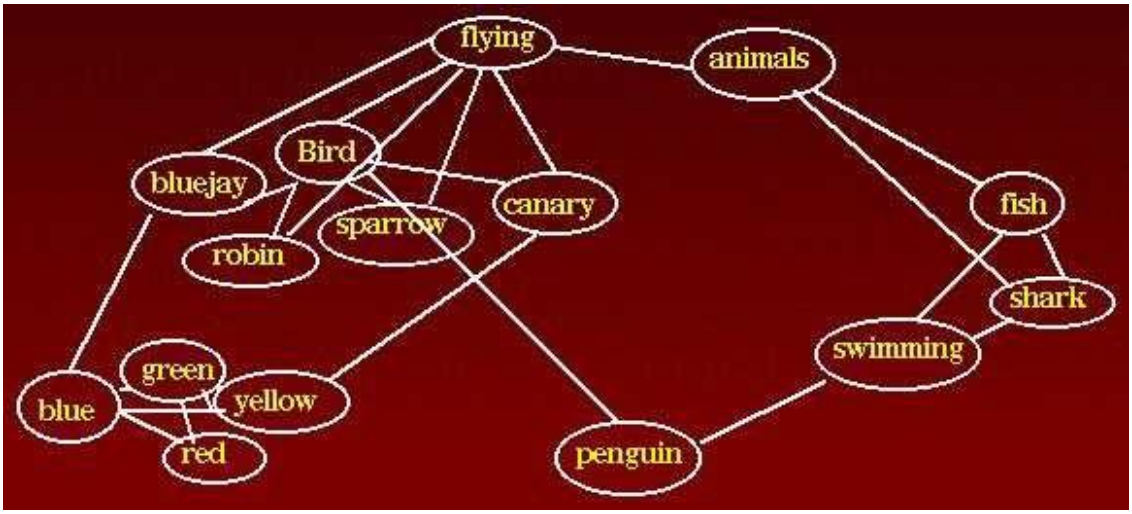
Not the same thing as remembering what happened yesterday as opposed to a long time ago. The conscious is short term memory. Long Term Memory is an infinite storehouse. After 20 seconds what we can remember is long term memory. So, short Term Memory is limited in capacity.

Working Memory: an activation model

John Anderson worked a lot on parallel process. He presented this activation model and said working memory sees short term and Long term memory as qualitatively different. But some other psychologists see LTM and STM similar but with some differences. There are certain differences. According to activation model working memory has something which has a certain level of activation (above threshold). Outside information is also involved in this activation model.

The items in working memory are defined by a high level of activation, which enables reliable and rapid access to them. Attention is a part and parcel of this activation mechanism off short term working memory. Attention relies on rehearsal. There is limitation in Short term memory rehearsal. If unattended the items in working memory will rapidly decay away in their level of activation. One can maintain items in working memory by rehearsing them and keeping them in a highly active state. There are limitations on how many items one can rehearse before they decay.

Activation in a network



This is a network of words. We can say this is a semantic network. Different words with links are presented. Like at bottom there is a word penguin. This word has two direct links swimming and bird. These two words have other links like shark, flying, animals, fish, and sparrow. This is a network of long term memory. These networks help in the activation of short term memory.

For example, if there are some concepts related to penguin like sea, atmosphere then we can recognize this penguin.

If we are seen desert we can remember camels. Because we are used to see camel in desert. So, these all information is saved in our long term memory, with clues we can remember things like camel in desert. So the effect of context is also very important even in working memory because it active other related nodes.

Magic number 7

John Miller was a great cognitive psychologist. He presented model of memory.

He wrote in an article,

> "My problem is that I have been persecuted by an integer. For seven years this number has followed me around, has intruded in my most private data, and has assaulted me from the pages of our most public journals. This number assumes a variety of disguises, being sometimes a little larger and sometimes a little smaller than usual, but never changing so much as to be unrecognizable. The persistence with which this number plagues me is far more than a random accident. There is, to quote a famous senator, a design behind it, some pattern governing its appearances. Either there really is something unusual about the number or else I am suffering from delusions of persecution."

This number is 7. He said it is very important. It is limit of items how many items we can keep in our memory. Plus minus 2 is range of 7.some people can remember 5 numbers and some can remember 9 numbers. It means 7-2=5, 7+2=9.

We can understand this by an example. We give a list of 7 digits to our friends for remembering. It is normal if people can recall 5 and 7 digits. But if people can recall less than 5 then there is some problem with these people. Some people have good memory they can recall 9 digits.

If we look in our religion we have seven days in our week. There are seven seas, seven continents, and seven skies. So 7 is our limit of our short term memory.

A question arises here, that is people can learn more than 7 words, 7 letters, seven sentences.

These seven letters LJKWNPR are easy to learn. But if this list of cities,

London, Paris, Munich, Berlin, Madrid, Prague, Stockholm, is given to people. People can learn it. So, how interesting people can learn these 40 digits? So, magic number & is not physical unit it is semantic unit or meaningful unit.

An example of all this can be, you are in a market and watching shirts, you like 30 shirts but you can remember only 7 or 8 shirts in short term memory at a same time. Some people collect samples and then select the best possible from these samples.

In decision-making, need for awareness of limitations of Short Term Memory. Our long term memory has a long storage capacity but our short term memory is limited. That's why people need to keep diaries. They note all important things in these diaries. Because our short term memory does not have capacity.

Chunking

There is another way of remembering things that is chunking.

For example a telephone Number in USA is 6174927861. this number has more than 9 digits. It is not easy to recall it. So the easy way to remember this number is chunking. Like

617-492-7861

In Pakistan people make chunks in different way than USA like,

617-49-27-861

But some time problem can arise when we tell phone numbers to a person who has different way of making chunks. Like some recall three by three digits, some recall digits two by two. So other can face problem in remembering others chunks.

Chunking is a way to increase capacity. Capacity of STM varies with meaningfulness of the material. A chunk is a memory unit. STM capacity is not limited by a physically defined unit but by a meaningfulness unit. Through chunking we can learn 21 digits at a time. Words limit is seven. But the capacity of sentence is much lower than letters and words.

Lesson 26

Memory

Chunking

Chunking is a way to increase capacity. Capacity of STM varies with meaningfulness of the material. A chunk is a memory unit. STM capacity is not limited by a physically defined unit but by a meaningfulness unit. Through chunking we can learn 21 digits at a time. Words limit is seven. But the capacity of sentence is much lower than letters and words.

In nursery classes chunking is used to learn the lesson to children. Like, 1, 2 buckle my show, 3, 4 shut the door. This (shut the door) became one unit or chunk. And 5, 6 pick up sticks.

Individual differences in chunking

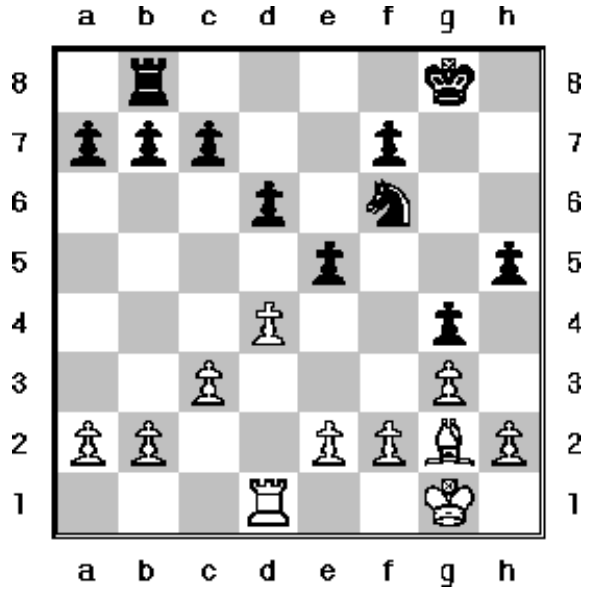
Example of Chess Players:

Chess is a queen of games. Because it needs high level of thinking.

De Groot wrote a book on chess in 1965. The name of book was *Thought and Choice in Chess.* He combined his all researches on chess in this book.

Chess Masters differ because of different perception and Memory rather than thinking. Grand master automatically plays games. But a new or inexperienced person takes long time to play. We all have same working memory limits. But the orientation is different. There are 16 black pieces and 16 white pieces on chess board. At a time we are able to use only 7 pieces. If we make a chunk of meaningful pieces. Then we are able to use more. For example we make a chunk of 3 pieces. Then we can use 21 pieces (7 chunks) then we easily remember our 16 pieces.

In experiment, People were asked to look at picture of chess board. And subjects were told that 20 moves had done into the game. They were asked to view the board- removed pieces for 5 seconds. Subjects put pieces back. Experimenter removed incorrect pieces-try again. Subjects were given 12 trials. The picture of chess board is given below.



Results & Implications

Results of experiment were that grandmasters performed 90% accurately on first trial. And novices played 40% accurately on first trial. The difference decreases over 12 trials. No differences between them on guessing. The grandmasters performed best because they chunk

pieces together into patterns. So they can remember it better. And may be the other reason of their performance is that they were told that the 20 moves had done. And what is the pattern? Grandmasters are expert they can guess what the board situation is after 20 moves.

Memory Aided Pattern Perceiver (MAPP)

MAPP is a computer chess program. Simon & Gilmartin (1973) extended the De Groot's work. And they made a computer chess program for computers. They made 572 chunks with different pattern from 2 to 7 pieces each. Program was more effective than a class-A player but not as good as a master player. There is a high correlation between pieces remembered by MAPP & Master Players. Those people make chunks and store different patterns they can perform best. Chunking for chess is over time chunking. It is changed within time or moves.

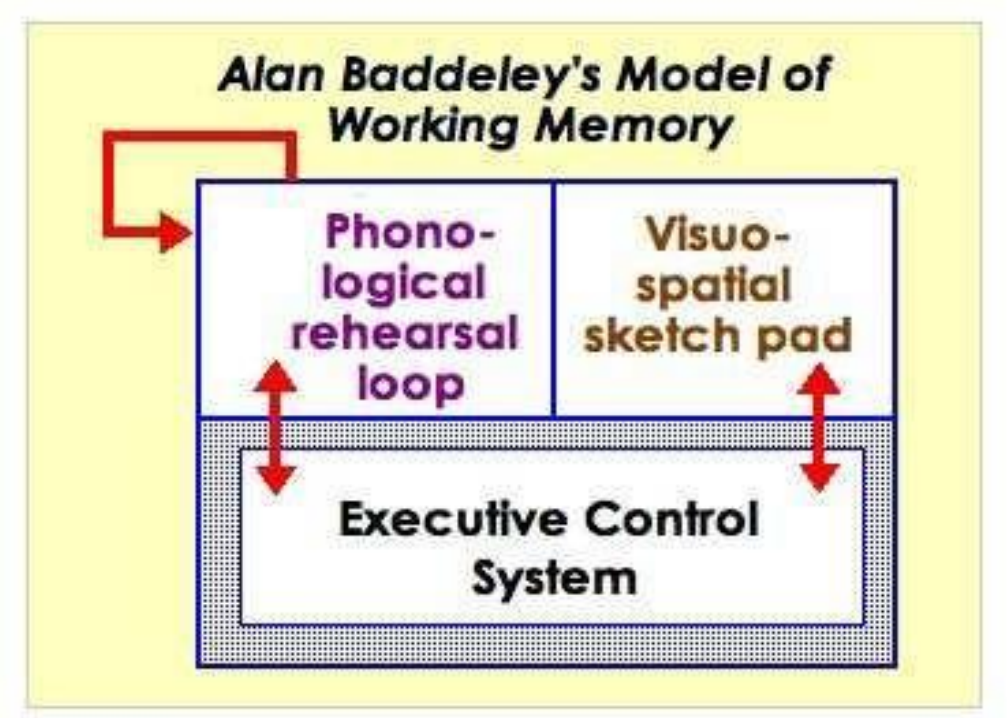
Individual differences

Master Players have between 10,000 and 100,000 chunks stored in Long Term Memory.

They have large pattern of chunks that's why they perform best in doing chess. These chunks are activated into Short Term Memory.

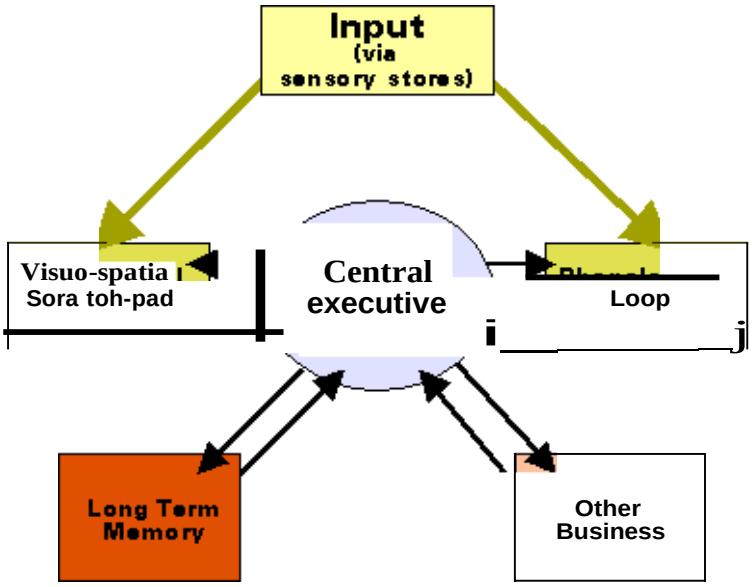
Alan Baddeley's Model of Working Memory

Alan Baddeley's presented a model of working memory. The simple representation of his model is given below.



He said about sound rehearsal not meaning. He talked about a phonological rehearsal loop because of sound rehearsal. For example we revise telephone numbers not because of meaning but because we want to remember that. But on chess board we can not verbally rehearse visual image. In our short term memory we have a sketch pad. On that sketch pad we watch important things.

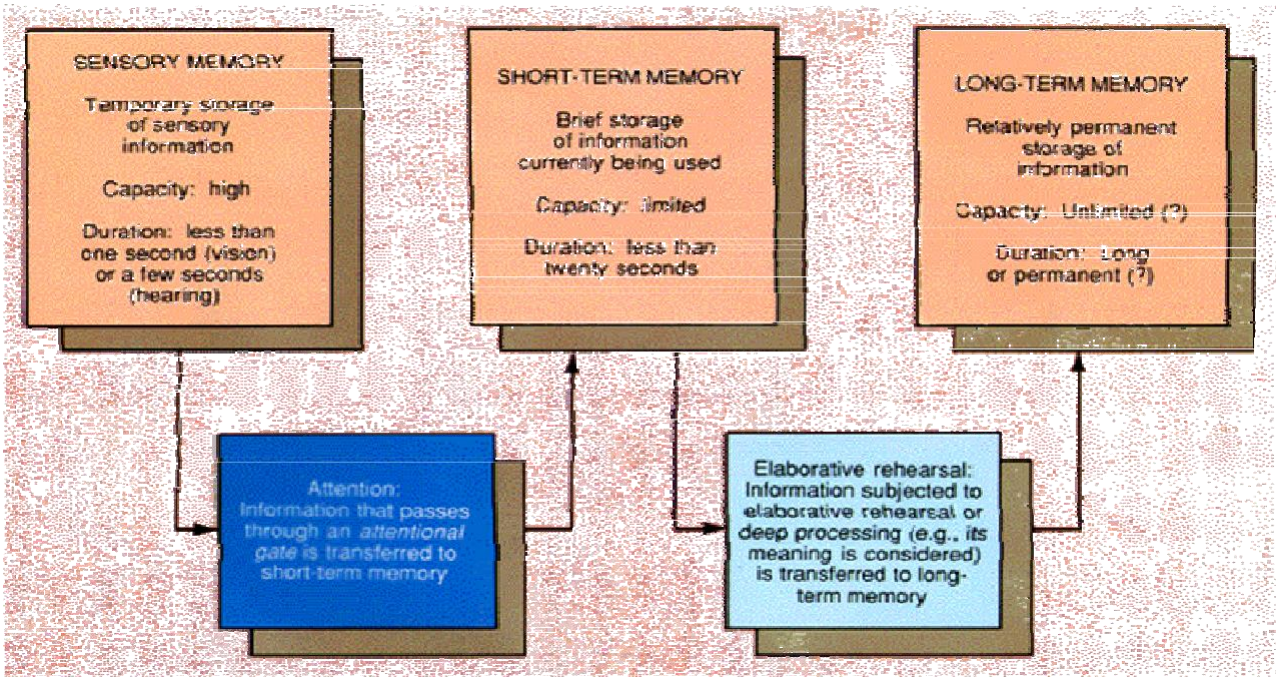
He also said about central executive that control all the memory system. This central executive decides about attention, and memory. This central executive makes decision about the information that it match with long term information or not. This is the broader concept of Baddley's model. According to this sloop process every decision is made by this central executive.


Input
(via
sensory stores)
Visuo-spatia l
Sora toh-pad
Central
executive
Loop
Long Term
Memory
Other
Business

Lesson 27

MEMORY

This following model is showing the whole process of memory. First of all there is sensory memory. Information from environment comes in sensory memory then those information receive attention goes to short term memory. After elaborative rehearsal the information transfers short term memory to the long term memory. The descriptions of all these memories are given in the figure.



THE NATURE OF FORGETTING

Decay Theory - forgetting occurs due to passage of time.

Interference Theory - memory for other things or performance of another task interferes with memory. Two types of interferences are given below;

Retroactive interference: later occurring information interferes with earlier information.

Proactive interference: earlier occurring information interferes with later information.

Keppel & Underwood:

Items on trials 1-3 are similar and on trial 4 they may be similar or may be different. When items are similar they interfere with one another; when they are different they are more readily recalled. This is called proactive interference.

Release from PI

Wickens, Born & Allen (1963) conducted an experiment to show the proactive interference. They showed 3 numbers or 3 words. They showed words or numbers for 20 second interval (another task).

In experimental group, after number they showed words. And after words they showed numbers. The performance of that group was 85%,40%,30%,84%

In control Group, they showed words after words and numbers after numbers. The performance was 85%, 40%, 30%, 25%.

Release from PI

Another experiment was conducted by Gunter, Clifford & Berry (1980). In that experiment three items in TV news were presented. One group was shown sports news and other group was shown political news. In experiment first of all three political items were presented to the political news group and then they were shown a sports news item. In other condition three sports items were shown to the sports group and then they were presented a political news items.

The results of that experiment was

Control Group performance in four trials: 87%, 67%, 55%, 43%

Experimental Group performance in four trials : 82%, 67%, 55%, 74%

Implications

The implications of these experiments are

Interference can be reduced by studying different things at the same time.

Similar things might interfere with each other.

But this is not to be confused with studying which requires similar things to be grouped together for better recall.

STM strategies

It is OK to study similar things together.

When you feel these are interfering with further learning, switch to something else.

STM & Working Memory

A different point of view is whether the STM and working memory are same or different.

Klapp, Marshburn & Lester (1983) said Working Memory is different from STM?

A model proposed by Engle, Kane & Tuholski (1998) suggests not Short Term Memory necessarily different from the working memory but it is a part of working memory.

Working Memory

Engle's Model:

1. Central Executive

(Working memory capacity, controlled attention) attention is a part of working memory. The task of central executive is to achieve activation through controlled retrieval.

Another task of central executive is to maintain activation.

Another function of central executive is to block interference through inhibition of distractors.

2. Short Term Memory

Central executive moves toward STM. In short term memory traces become active above threshold, with loss due to decay or interference.

Some traces receive further activation by becoming the focus of attention. Trace consists of a pointer to a region of Long Term Memory. Trace is not a part of long term memory from short term memory. Trace is a pattern and it ahs a indicator of information.

3. Grouping Skills, coding strategies and procedures for maintaining activation

Information could be phonological, visual, spatial, motoric, auditory, etc.

Grouping skills, strategies, and procedures for maintaining activation are more or less attention demanding on the task and the subject.

The important thing of this model is it gives a prominent role to the central executive. It is a decision making personality.

In Engle's model the prominent Role was also given to Central Executive.

The Central Executive manages controlled attention – capacity model of attention and allocation of attention in working memory can be explored.

Another important thing in this model is STM maintains activated memory traces. Like Phonological loop, scratchpad, touch short term memory etc.

A model of Consciousness

Another perspective of short term working memory is that it is also related to the consciousness. Working memory is a way of looking toward the consciousness. Working Memory should rekindle discussion of consciousness.

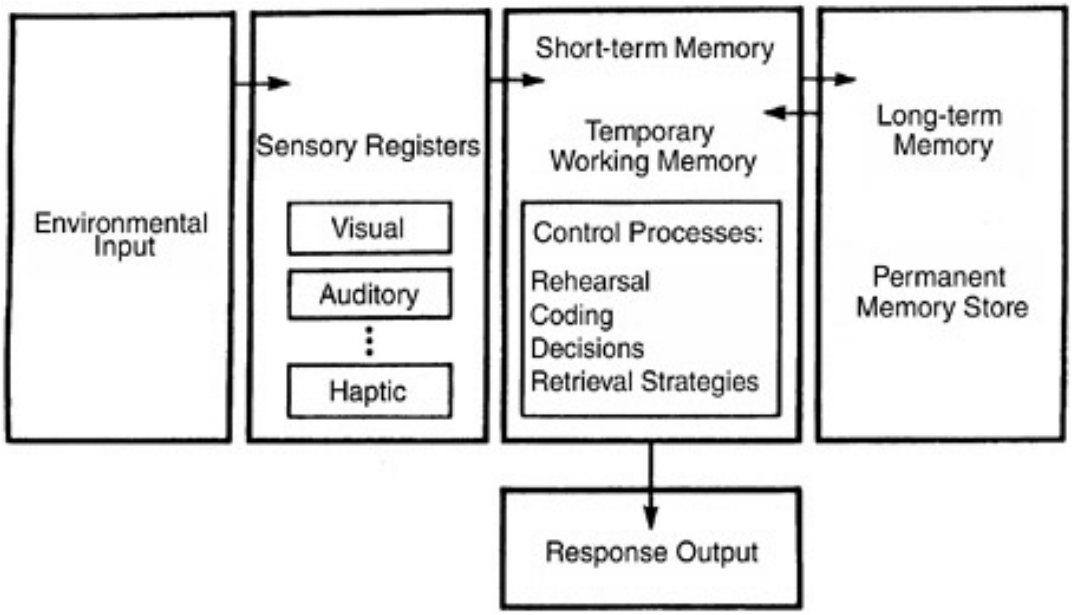
STM determines the limits of the present. The Psychological Time of short term memory is from 1 second to 20 seconds. The stream of consciousness made up not of past events but on present discrete time units.

Lesson 28

Memory

Atkinson & Shiffrin Model

Before studying long term memory, the overview of Atkinson and Shiffrin model is very important. It gives us overview and makes us see where long term memory belongs.



In first box there is environmental input. First of all the input comes in sensory register from environment. This information may be visual or auditory etc. then this input goes to short term memory. Arrows are showing this process.

Sometimes we listen a word that we have listened ago. It has been stored in our long term memory. Short term memory pull out information from long term memory and match this information with environmental input or information and then response out put.

In short term memory there are control processes. These processes happened in short term memory. These are rehearsal, coding, decisions and retrieval strategies.

Like when someone tells us telephone number we want to store it in our mobile. Until we do not store this number we rehearse the number in our mind. If we want to remember the information, for long term, we code the information in someway. We make decisions about information at our short term memory stage. Or short term memory makes decisions. The strategies of revision are also present in our short term memory. For example if we are shopping the things in market we make decisions to buy the things.

Our current information goes into long term memory and stored information in long term memory comes in short term memory. For example a depressive patient remind all his or her past life events that make him or her more depressive. So therapists help patient to forget old things. These old things are stored in long term memory. Long term memory is permanent memory. LTM provides information according to context and scenario. Long term memory already creates set or pattern in short term memory. The concept of LTM is closely related to the STM. Long term memory constantly interacts with short term memory. Every experience, sensory experience, every thing is survived or stored in our long term memory.

Long Term Memory

A memory that lasts more than 20 seconds is Long term memory.

So if you can recall something after 20 seconds it is in your LTM.

What is it?

Through repetition the information is stored in our long term memory.

Different things to different people

Memory has different meanings for different people.

Memory for students is about studies.

Memory for older people is about finding keys.

Memory for young children is about remembering how to tie their shoe laces.

Memory for scholars is about remembering what the book was all about.

So, there are different questions we have about memory.

Different kinds of LTM

There are different kinds of Long term memory.

1. **Episodic versus Procedural**

Amnesia patients forget their names but don't forget how to brush their teeth.

Like in films or movies, hero or heroine is injured and his or her memory is lost. They forget about themselves but they know how to wear dress or how to make shave.

So in amnesia episodic memory become upset.

2. **Semantic versus Sensory**

In semantic memory we remember meanings of things. Like what is home? What is book? What is rose?

Sensory memory means we remember analog representations of things. Sensory representation is analog representation .It represents original things.

Like recall a perfume, imagine the taste of chocolate. What is a smell of rose?

3. **Implicit versus Explicit**

Things you learned on purpose as opposed to things you learned anyway, like teacher shouting

What do we study?

Transfer from STM into LTM

Retrieval from LTM back into STM

Recall versus Recognition

Applications

Studying and testing

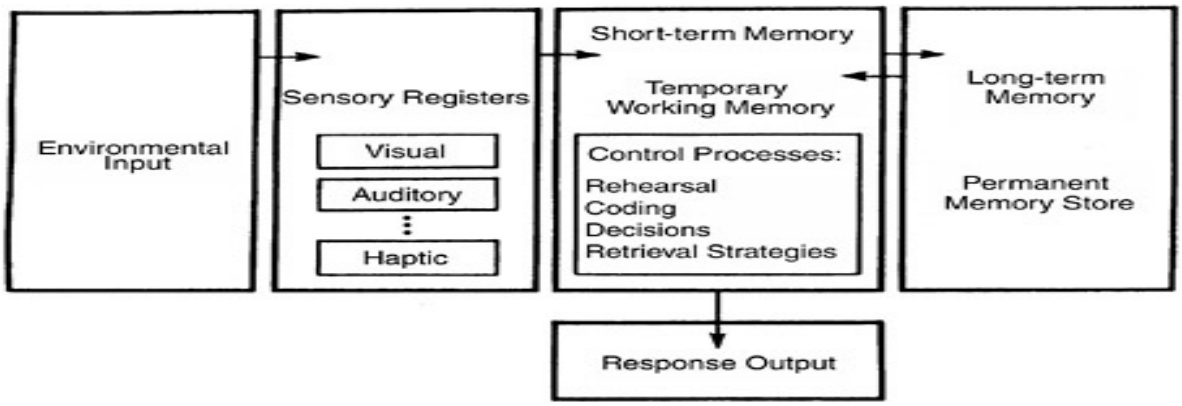
Role of rote learning

Eyewitness testimony

Lesson 29

Memory

Atkinson & Shiffrin Model



This model is explaining the whole process of memory in short. How the information goes in sensory register then in short term memory and in long term memory that is permanent store information.

What do we study?

These all are the brief concepts in the study of long term memory.

Transfer from STM into LTM

Retrieval from LTM back into STM

Recall versus Recognition

Applications

Studying and testing

Role of rote learning

Eyewitness testimony

Long Term Memory

Cognitive psychology is about experiments. Psychologists do experiment to generate models, and refine models.

Experiment

An important experiment was conducted by Anderson in 1976 to illustrate how speed of retrieval varies with practice. In first phase they were given these sentences.

The Sailor is in the park.

The lawyer is in the church.

Subjects drilled over and over again until they know by heart.

Having these two sentences the subjects were tested on these sentences and asked whether each was among the sentences they had studied.

The sailor is in the park.

The sailor is in the church.

Subjects knew the material enough to be correct almost all the time, experimenter was interested only in the speed with which they made their correct recognition judgments.

Difference in study is because of the delay in presentation.

Results

The findings were:

	Short Delay	Long Delay
Less Study	1.11	1.53
More Study	1.10	1.38

The time span of Less Study is .42 and More Study .28.

In less study and short delay condition subjects were fastest. And in more study condition with short delay condition the rate was same. But in long delay condition and less study condition the reaction time is 1.53.

Delay made difference. And more study also made difference.

The implication of this study was weaker memories take longer time to reactivate. If we want to remember a thing we have to study it more.

Spread of Activation

Perlmutter & Anderson conducted an experiment that is unpublished, and cited in book of Cognitive psychology.

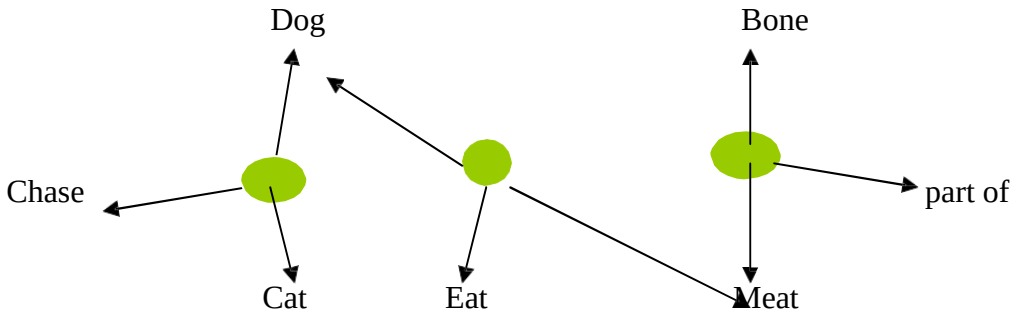
In that experiment; subjects were presented with a sequence of words and asked togenerate associates that began with specific letters. They had two conditions.

In priming condition there is pair of letters and words but these letters and words are associated. Like Dog C for Cat, and bone- m for meat. In control condition the words and letters are unrelated.

Priming	Control
Dog - C	Gambler – C
Bone – M	Bone – M

The reaction time of priming condition is 1.41 sec. and the reacton-time of

Control condition is1.53 sec.



This network model is explaining the difference in both conditions. Through the word eat both dog and bone is linked. There is relationship between these words. The results showed the priming condition is easily recalled. Therefore the activating the network structure to answer the first associate should help activate the structure needed to answer the second. This experiment showed activation spreads through long term memory from active portions to other portions of the memory and this spread takes time.

Associative Priming

Mayer & Schvaneveldt (1971) performed a classic demonstration of associative priming. They had subjects judge whether or not pairs of items were words.

Positive Pairs Negative Pairs

Unrelated	**Related**	**Non-word 1st**	**Non-word 2nd**	**Both non-words**
Nurse	Bread	Plame	Wine	Plame
Butter	Butter	Wine	Plame	Reab
940	855	904	1087	884

If either item in a pair was a non-word, subjects were to respond no. where the top item was a non-word, subjects were faster to reject the pair than when only the second item was a non-word. Where the top item was not a word, subjects did not have to judge the second item and so could respond sooner.

Subjects were fastest in the both non-words condition. Subjects were faster in the non-word first condition than in the non-word second condition. In positive pairs subjects were much faster in related pairs than in non-related pairs.

Implications

This result indicates that because subjects judged the first item to be a word, activation spread from that word and primed information about the second, associatively related, item.

Judgment takes place in the working memory. The represenatation of the word has to be active in short term memory.

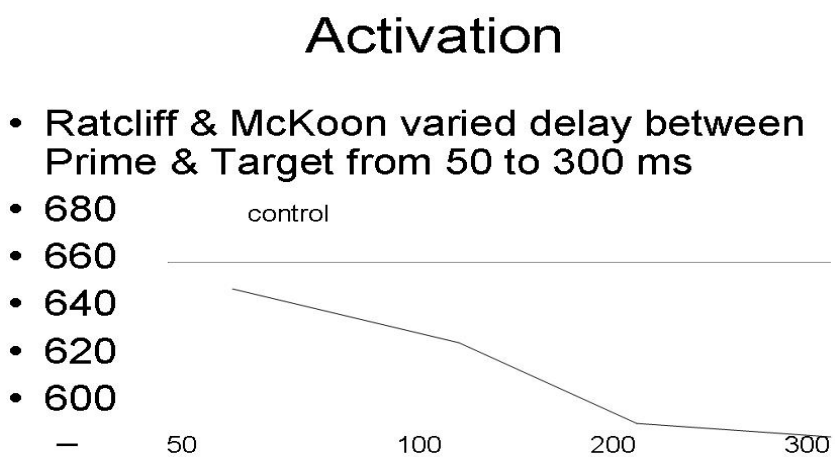
We can read related material faster than non-related incoherent material where words might be presented randomly.

The implication is that the associative spreading of activation through memory can facilitate the rate at which words are read.

More Priming

Ratcliff & McKoon (1981) report a rather different priming demonstration of spreading activation. They had subjects commit to memory sentences such as The doctor hated the book. Subjects had to decide whether the noun “book” was in the studied sentence. Sometimes a prime word such as “doctor” was presented just before “book”.

Ratcliff & McKoon varied delay between Prime & Target from 50 to 300 ms. All of these intervals were too short for subjects to develop any conscious expectations. The decrease in the reaction time reflects the growth in the level of activation.



Implications

The implications of the experiment were

There is a strong effect of priming in the Long Term Memory that is strength of coding.

Activation spreads quickly up to 200 ms after which it slows down.

For recognition, information must first be activated and then inspected. Activation must spread to info in LTM to be brought into STM. This takes time (200 ms).

We see the short term memory and long term memory are interacting. STM has less storage; at one time it has 7 things. LTM keeps information all things. It has unlimited capacity for keeping information. Another problem in STM is it has only 20 seconds duration of storage. But long term memory has permanent storage.

For information to be used in a task as a recognition judgment, it must first be activated and then inspected. When information is in long-term memory but not currently in working memory, activation must spread to it, which takes some amount of time, as we saw in the McKoon and Ratciliff study. Once activated, the time to inspect the information will depend on its level of activation, as was illustrated in the Sternberg experiment.

Lesson 30

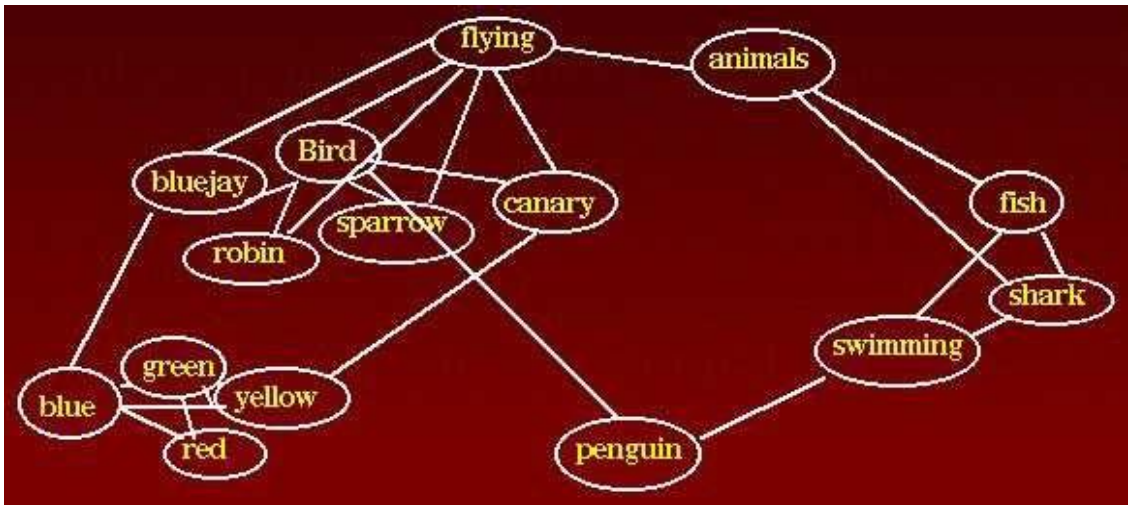
Memory

Interference

Various factors can affect the amount of activation that is spread to a knowledge structure. From the previous experiments we can infer that strength of encoding has an effect such that more strongly encoded information receives greater activation. Another factor is the number of alternative network paths down which activation can spread.

Encoding is a process of transfer the information from short term memory to long term memory through codes.

This following figure is showing the activation in a network. The word penguin has two links, one is bird and other is swimming. Bird and swimming have their links as well. If we think about swimming the activation model will become active and we can recall penguin because of its connection with swimming.



The Fan Effect

Anderson (1974) performed an experiment. He had subjects to memorize 26 facts. In these statements some persons were paired with only one location and some locations with only one person. Other persons were paired with two locations and other locations were paired with two persons. Each statements was followed by two numbers, reflecting the number of facts associated with the subject and the location. For instance, sentence3 is labeled 2-1 because their subject occurs in two sentences (sentences 3 and 4) and its location occurs in one sentence (sentence 3). The sentences were;

The doctor is in the bank. (1-1)

The fireman is in the park. (1-2)

The lawyer is in the church. (2-1)

The lawyer is in the park. (2-2)

Number of facts associated with subject and location.

Subjects were drilled on each sentence. Before beginning the reaction time phase, subjects were able to recall all the locations associated with a particular type of person (e.g. doctor) and all the people associated with a particular location (e.g. park). Then they began a speeded- recognition

phase of experiment, during which they were presented with sentences and had to judge whether they recognized them from the study set. Foil sentences were created by repairing of people and locations from the study set.

Results

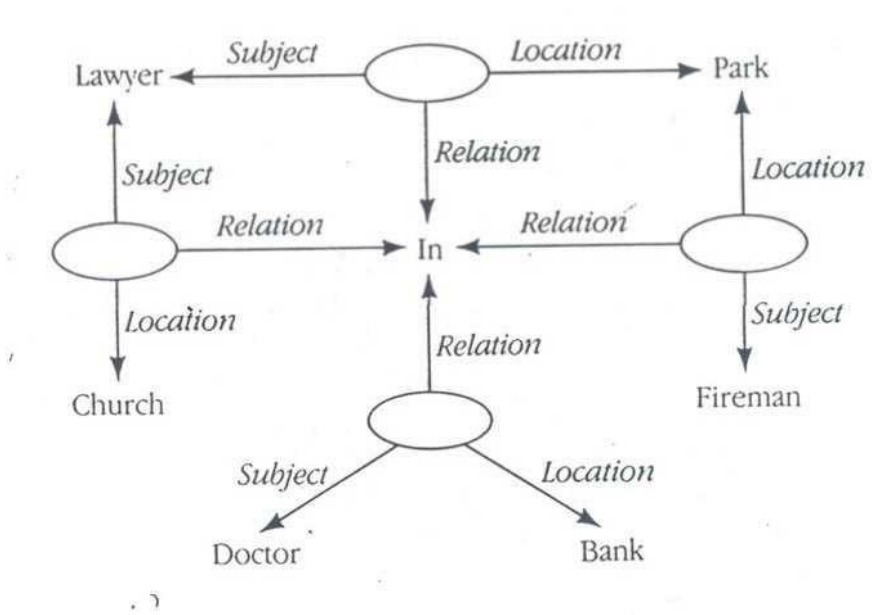
The recognition time for sentences as a function of number facts learned about persons and location.

Specific Location	Specific Person	
	1 sentence	2 sentences
1sentence	1.11	1.17
2 sentences	1.17	1.22

Results are showing recognition time increases as a function of both the number of facts studied about the person and the number of facts studied about the person and the number of facts studied about the location.

The Fan Effect: Network

The network



representation for sentences 1 through4 is given below.

Every node has three parts such as relations, subject, and location. By applying the activation concept to this representation, we can nicely account for the increase in reaction time. Subject might recognize such as probe as a *lawyer is in the park.* First suppose the presentation of terms lawyer, in and park serves to activate their presentations in memory. Then activation will spread from these nodes to activate the target proposition and enable it to be recognized. Fireman and lawyer interfere with park. But there is no interference between doctor and lawyer, so there is no fan effect.

The Critical Assumption

The amount of activation reaching the proposition is inversely related to the number of links leading from it.

Subjects should be slower to recognize a fact involving lawyer and park than one connecting doctor and bank because more paths emanate from the first set of concepts. That is, in the lawyer and park case two paths point from each of the concepts to the two propositions in which each was studied, whereas only one path leads from each of the doctor and bank concepts.

Activation: Limited capacity

This is one experiment among many points to a limited-capacity feature of the spreading-activation process. The nodes, such as lawyer and park, from which the spread of activation starts can be called source nodes. One node can has thousands nodes. This one node supply energy to other nodes the energy of this node is also transfer to other but in a very limited amount. Like in an example of experiment of last lecture the word dog is also activate other kind of dogs, meats, bones and other animals.

A source node has a fixed capacity for emitting activation. This capacity is divided among all the paths emanating from that node. The more paths that exist, the less activation will be assigned to any one path and the slower will be the rate of activation.

At one time we can make many nodes with one word. Like the word fish has many links. We can remember many other things, like other kind of fish, water, sea, other sea animals etc.

Another example of Gambler, we can make many links with this word like cards, the pictures on cards, the figures of cards etc.

Interference

The fan effect is the name given to this increase in reaction time related to an increase in the number of facts associated with a concept. It is so named because the increase in reaction time is related to an increase in the fan of facts emanating from the network representation of the concept. The term conveys the fact that additional information about a concept interferes with memory for a particular piece of information. Interference affects a wider range of measures than just recognition time. Fan effect is reserved for interference effects as measured by reaction time.

Lesson 31

Memory

Interference

The fan effect is the name given to this increase in reaction time related to an increase in the number of facts associated with a concept. It is so named because the increase in reaction time is related to an increase in the fan of facts emanating from the network representation of the concept. The term conveys the fact that additional information about a concept interferes with memory for a particular piece of information. Interference affects a wider range of measures than just recognition time. Fan effect is reserved for interference effects as measured by reaction time.

Historical Memories

Lewis & Anderson (1976) investigated whether he fan effect could be obtained with material the subject knew before the experiment. They had subjects learned fantasy figures for example, Napoleon Bonaparte was from India. Subjects studied 0-4 fantasy facts about each public figure.

After learning these facts they proceeded to a recognition-test phase. In this phase they saw three types of sentences:

Fantasy world statements, true statements, and false statements like

1) Statements they had studied in the experiment
2) True facts about the public figurers (such as napoleon bonapartae was an emperor);
3) Statements about the public figure that was false both in the experimental fantasy world and in the real world.

Subjects had to respond to the first two types of facts as true and to the last type as false.

Results

Subjects responded much faster to actual truths than to experimental truths. The advantage of the actual truths can be explained, because these true facts would be much more strongly encoded in memory than the fantasy facts because of greater prior exposure. The more fantasy facts one learned about a person, the longer it took them to recognize something they already knew about the person; Napoleon was an emperor.

Interference and Retention

Now we will consider what happens as these interfering effects get more extreme-either because the to-be-recalled fact is very weak or because the interference is very strong.

There is evidence that the subject simply fails to remember the information under both conditions. Results showing such failures of memory have traditionally been obtained with paired-associate material, although similar results have been obtained with other material.

Experiment

In a typical interference experiment, two critical groups were defined.

The A-D experimental group learns two lists of paired associates**,**

The first list is **List A-B:** cat-43 and house-61

And second list is **List A-D:** cat-82 and house-37

The C-D control group also first studies the A-B list, but then studies a different second list,

List C-D is bone-82 and cup-37, which does not contain the same stimuli as the first list.

After learning their respective second lists, both groups are rested for their memory of their first list, in both cases the A-B list.

Results

In general, the A-D group does not do as well as the C-D group with respect to both rate of learning of the second list and retention of the original A-B list.

The results are presented in following figure.

TABLE 7.1: EXPERIMENTAL AND CONTROL GROUPS USED IN A TYPICAL INTERFERENCE PARADIGM

A–D Experimental		C–D Control	
Learn	A–B	Learn	A–B
Learn	A–D	Learn	C–D
Test	A–B	Test	A–B

Implications

The implication is that failure to recall is the extreme case of a long retrieval time. Thus, it is not the case that the forgotten information is not in memory, but rather that it is in memory but is too weak to be activated in the face of interference from other associations. Paired associate memory is too weak to recall.

Forgetting is not actual loss of information but rather loss of ability to activate that information.

Recall versus Recognition

Consistent with the hypothesis that there exists in memory information that we can not recall is the fact that we can recognize many things we cannot recall. This phenomenon suggests that information can be in memory even though it cannot be activated in the recall test situation. The memory network analysis makes clear the reason that recognition often works even when recall fails. So, recognition is generally better than recall. For example if there is a question

Who invented the lenses we use in spectacles?

Then a huge fan of information networks becomes active. We recall a lot of information that is related to glasses or spectacles.

For example someone mention Ibn-al Haitham invented the lenses we use in spectacles. If we have listened this before now, then we can recall this answer because of strong enough information. So, Joint activation helps the second statement.

There are many other possibilities. If with this question (Who invented the lenses we use in spectacles? we have some options like, Michael, Ibne Batota, Albaroni and Ibn Al Haitham. Now these options interfere with our information. And we become confuse. But because of our links or network we can recall correct information. Like spectacles were invented by Muslim scientist so, Michael could not be answer.

So, recognition is typically better than recall because a recognition test typically provides more sources for activating memory. Recognition test is better than recall test. Tip of the tongue is happened in recall not in recognition.

For example, if you see a man you say you have seen him before. So you can recognize him. But you are not recalling his name.

In our daily life, in our exams, in any test or in other situation we think recognition is our friend and recall is not much friendly.

Another example is if someone asks you when Baber came in Hindustan and invaded Hindustan. The chances are we could not recall. If someone gives us some options like, 712, 789, 1566 and 1020 with question. Then it becomes easy to recognize when Baber invaded India.

So the conclusion of all that is recognition is a better and easiest task than recall.

Lesson 32

Memory

Long Term Memory

Recall versus Recognition

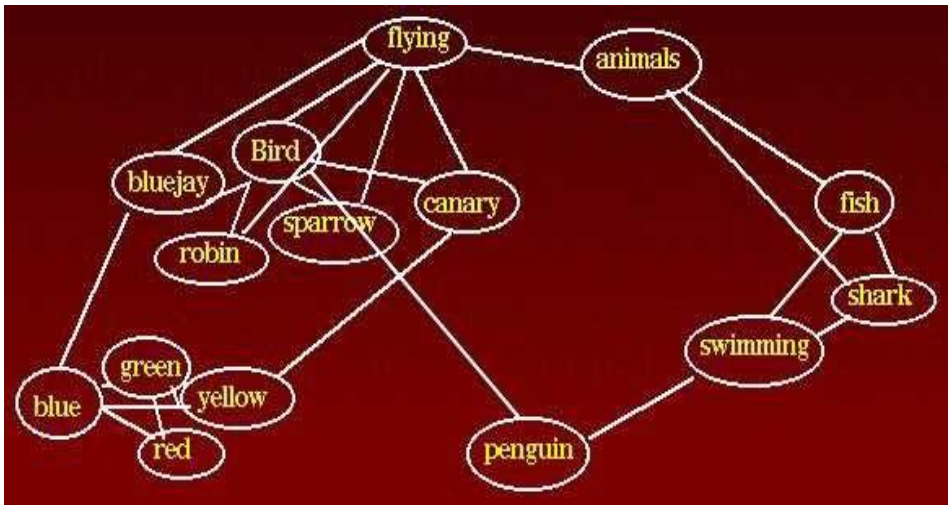
Eye witness testimony or expert witness

When we recognize others we make our own ways. For example we see Chinese and recognize them as Chinese because of their small eyes and foreheads. We also perceive black farm people same. This is just because of the things that we see common in all black farms. So, false testimony can be made by people. For example a white man sees a black farm man at night then he thinks other black farms are same like that black farm.

Our memory is inference by our contextual clues that are saved in our long term memory. We use these clues or information from our memory to fill our gap.

Activation in network

The following figure is showing the activation in a network. The word penguin has two links, one is bird and other is swimming. Bird and swimming have their links as well. If we think about swimming the activation model will become active and we can recall penguin because of its connection with swimming. So the words are linked with other so many words. By remembering one word we can recall others as well.



So, in our daily life if we want to learn things if we make links of this information then it become easy to remember or recall. For example we want to learn an essay of parents, we make different links like father, mother, love, affection, help, sacrifice, food, help etc. so, students should make links among information they can easily recall information in exams.

Even in the case of historical memories if we make links it become easy to recall. For example you want to recall who made or discovered Sulfuric Acid? If we have learnt it and make a link with it that sulfuric acid was made by Muslim scientist. Then we can recall it easily.

When the students are learning the lessons if they make a network of all material than they can easily recall it. If they make picture of material and learn it then it will also help in recalling. Because the memory of pictures is better and has deeper quality to recall than for words. Memory

for smells is long lasting than all other memories. For example you take just one drop of perfume and put it on the page where you are making network. Then it will help in remembering the information. Because, the association between interesting and boring things makes remembering easy and fast. It is called elaborate networks

In all kind of material sciences, like physics, chemistry, biology, mathematics, all kind of information becomes easy because of these elaborate networks. Different pictures or figures are also given in books because these figures help in remembering things easily. Even in subjects of History or Islamiyat different hierarchies and tables are also given.

Another example of memory for smells is that mostly the females use diaries that have smell. Some females or people put some perfume on their notebooks.

Are forgotten memories lost forever?

An important issue to consider while talking about the memory is that whether or not the forgotten memories are lost for ever.

An interesting possibility is that we never do really lose our memories that forgotten memories are still there but are too weak to be retrieved. Penfield (1959) conducted an experiment to report this notion.

In that experiment as a neurosurgical procedure, he electrically stimulated parts of patients' brains and asked them to report what they experienced (patients were conscious during the surgery but the stimulation technique was painless). In this way Penfield was able to determine the function of various portions of the brain. Stimulation of the temporal lobes led to reports of memories that patients were unable to report in normal recall, for instance, events from their childhood.

It was as if Penfield's stimulation activated portions of the memory network that spreading activation could not reach. Unfortunately, it is hard to know whether the patient's memory reports were accurate, since going back in time to check on whether the events reported actually occurred was nearly impossible. Therefore, although suggestive, the Penfield experiments are generally discounted by memory researchers. Even so, the question of forgotten memories and its importance remains the same.

Lesson 33

Memory

Long Term Memory

Forgotten Memories Exist

Nelson (1971) conducted an experiment and indicated that forgotten memories still exist. He had subjects learn 20 number- non paired associates; they studied the list until they reached a criterion of one errorless trial. Subjects returned for a retest two weeks later, recalling 75 percent of the items on this retention test. However, interest focused on the 25 percent items for which the subjects were given new learning trials on the 20 paired associates. The paired associates they had missed were either kept the same or changed. In a changed case, a new response was associated to an old stimulus. If subjects had learned 43 –dog but failed to recall the response to 43, they might now be trained on either 43-dog (unchanged) or 43- house (changed).

Results

Subjects were tested after studying the new list once. If subjects had lost all memory for forgotten pairs, there should be no difference between changed and unchanged pairs. However, subjects correctly recalled 78% of the unchanged items and only 43 percent of the changed items.

This large advantage for unchanged items indicates that subjects had retained something about the paired associates even though they had been unable to recall them initially. This retained information was reflected in the savings displayed in relearning.

Recognition of lost memories

Nelson (1978) also looked at the situation in which the retention test involved recognition. Four weeks after learning, subjects failed to recognize 31 percent of paired associates they had learned. As, in the previous experiment, Nelson had subjects relearn the missing items. For half the stimuli the responses were changed and for the other half they were left unchanged.

Results

After one relearning trial, Subjects recognized 34% of the unchanged items but only 19 percent of the unchanged items. The recognition-retention test should have been very sensitive to whether subjects have anything in memory. Even when the subjects fail this sensitive test, there appears to be some evidence that a record f the items is still in memory- the evidence that relearning was better for the unchanged than the changed pairs. Here is one example where recognition is worse than recall yet memory is still there.

Representation of knowledge

It is an issue of long term memory. That deals in what form the knowledge store in long term memory. The man issues of representation of knowledge are;

Digital versus analog

Propositional networks versus images

Dual Code Theory

Categories and concepts

Defining features

Necessary and sufficient features

1. Digital versus analog

2. Propositional networks versus images

In the propositional analysis only the meaning of an event is represented like fan effect. The unimportant details- details that humans tend not to remember- are not represented. In this network the information, relations, and the arguments are connected to each other and they make a network.

Dual Code Theory

Propositional Network Code

For example, my house is in Lahore. This line is stored in our memory. If one asks about the distance between our house and a hotel. Then to explain the distance we make different sentences and make links between different roads and stops then we are able to tell the distance. So, these sentences are stored in our memory. The information of abstract things are also stored n our mind like intelligence, love, honesty etc.

Images are stored

For example, The image of my house is stored.

There is a visual representation in our mind. Like different scenes. The presentation, smell, or taste of food is also stored in our memory. We can recall them even they are not there.

Categories

Cognitive psychology is a merger/union/meeting point of different types of knowledge e.g. philosophy, computer science, artificial intelligence, psychology, social work etc. etc.

The category fruits groups a lot of different kinds of objects that have essential features in common. It also excludes many objects belonging to other categories such as vegetables. Traditionally we have defined categories as having necessary and sufficient features

Definition of a Category:

"A category refers to a group of objects sharing the same essential features." e.g. bird, furniture, fruit, robin, etc.

There are many essential features that present in all fruits, like fruits are sweet, sour, ripe, different colors.

Categories

Dictionary Definition of Fruit (A category):

"The edible product of a plant or a tree consisting of a seed and its envelop. The envelop is juicy and pulpy." e.g. apple, orange and plum etc.

Necessary and sufficient features

Edible, Contains seed and juicy/pulpy envelope

Examples: Orange, Apple, Mango

Dictionary Definition of a Vegetable (A category):

"Edible plant product eaten raw or cooked." e.g. carrots, spinach, tomatoes etc.

According to biological classification system, "Fruit is that part of the plant which develops out of a flower and nurture seeds."

Necessary and sufficient features

Edible, Plants products

Examples: Carrots, Spinach, Tomato

Problem

In the biological classification system, fruit is that part of the plant which develops out of a flower and nurtures seeds. Tomato is a fruit in biology

For a chef, Tomato is a vegetable. The category vegetable does not exist in Biology.

Is chicken a bird or an animal?

Categories are not as neat and clean as philosophers would have liked them to be. In Biology Chicken is an animal and a bird. For a layperson, Birds have to be able to fly: it is a necessary feature of category bird. So people consider the chicken as animal because they eat it. But biologist consider chicken as bird and animal.

Categories are very important. Like letters are categories. If we know the categories of things we can recognize them even we don't know the exact thing. For example there are many types of dogs. We used to see some specific dog in our area; we have not seen German shepherd dog. But whenever the German shepherd comes in front of us we can recognize this is dog. That is because of category of dog and the essential and sufficient features of dog's category.

Pattern recognition is a part of category recognition.

Categories of Language

Categories are critical to our understanding of information processes. It helps us to know how we think about things that are around us. Language is also very important in category recognition. Because the words have different meanings in different languages. Sindhi, Blochi, Punjabi, Pashto there are many languages are spoken in one country.

Dialect versus Language

Some languages are dialect and some are proper languages.

Like some people say Punjabi is a dialect but some say it is a complete language.

Lesson 34

Memory

Representation of knowledge

Categories

Definition of a category: "A category refers to a group of objects sharing the same essential features."

Benefits of Categorization:

Categorization reduces complexity of the environment. Like example of dog in previous lecture. There are more than 7 million discriminable colors. But we can recognize in 7 colors. And we call almost 10, 0000 colors in one category. We have many categories of colors. For example there are many shades of green colors, like trees, parrot, etc all having green colors but they have different shades. Red colors also have many shades like, blood color rose color etc.

Categorization is means by which objects are identified. For example pattern recognition. Dog is a category even there are many kinds of dogs. If we have never seen particular object before but we can recognize it because of its category.

Categorization reduces the need for constant learning. We don't need to learn about the new dog but we know this is dog because it can bite and bark. No need to learn about every single object. Because we have learnt it before.

Categorization helps us decide appropriate action. We have categorized the thing that's why they are easy to learn and remember. For example we know about the things whether they are good or bad, poisonous or non-poisonous. We know how to behave in front of dog if the dog is guard dog, or kept dog. So our response is according to the category.

Categorization helps us order and relate object. For example a category of chair, there are many types of categories like there drawing room chair, kitchen chair, kid's high chair, dinning room chair, wheel chair. But the category is chair we have many sub categories. It makes difference and allows us to make a hierarchy of system that helps us ion ordering and relating things. Like Chair, highchair, furniture

Levels of Categories

i) Superordinate Category:

"It is a large category at the top of the hierarchy." Such as furniture, tools, vehicles etc. furniture is a large category it has sofa, bed, table, chair etc. tool is also a large category it has electronic tool, wood tool etc. vehicles is also large category. These are subordinate categories.

ii) Basic Level Category:

"It is an intermediate category in the middle of the hierarchy." e.g. Table, chair, bed, sofa etc. We have direct link with these categories. These are basic level because their subordinate category is furniture.

iii) Subordinate Category:

"It is a small category at the bottom of the hierarchy." e.g. lamp, screw-driver, truck etc. screw driver is a specialized category. There are many types of table such as, coffee table, lamp table, etc. another example is car like 100 cc car 800 cc car etc.

We can explain these three levels in this way :

Level 1. Furniture

Level 2. Chair

Level 3. Drawing room chair

Concepts

Definition:

"Concept is a mental representation of a category."

It is the mental representation or is the concept made up of the rules regarding necessary and sufficient features. Basically the concept means what you are getting in your head, is it the definition of a chair?

How the category is stored in the mind is about a concept.

A botany student's concept of fruit is slightly different from that of the chef. This is because they get this category in different way. Both define fruit in different way.

So categories are internal representation of categories.

Necessary & Sufficient Features of concept

It is the mental representation or is the concept made up of the rules regarding necessary and sufficient features.

What is this mental representation made up of?

For example Furniture

Furniture can be defined as Movable articles in a building. This is not a proper definition. Every definition has many problems even in this definition.

How do you group chairs, tables and sofas in furniture but children's toys are excluded?

Television?

May be wooden articles

What about metal sofas and tables

Drawing room, beds

Lamps

Lights etc

These all are movable things.

We can impose something in categories. But in concepts we can not. For example science students can define Tomato and Brinjal in different way but lay man define it different.

Mental Experiment

A mental experiment is to help in understanding the concept.

First close your eyes,

What comes to mind when I say furniture?

Write it down.

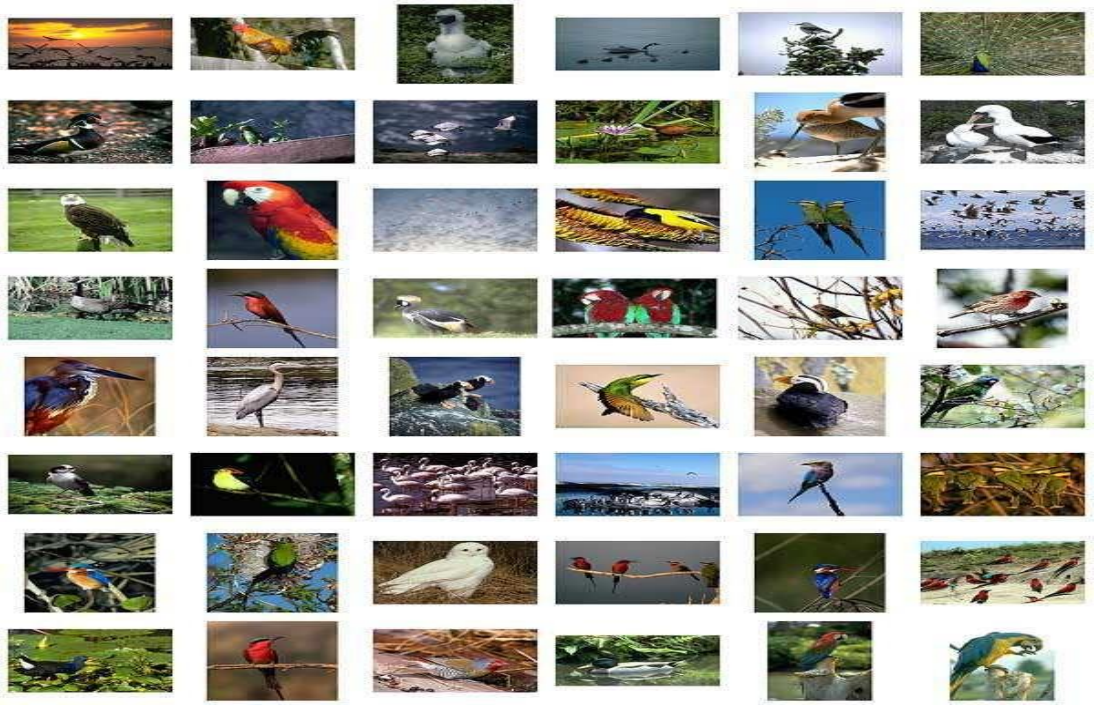
Now again close your eyes, what comes to mind when someone say chair?

Is it a definition? Or is it an example. It means when you close your eyes what comes in your mind the definition or actual image of chair at particular place.

Prototypes

Proto means "essential or basics" when we make new things first of all we make a proto that explain briefly the new things.

Typical features are averaged to make a mental representation. This unique representation may not match a single instance.



Look in the above figures there are many birds.

For example we watch many birds we note all features and then take average of all features. For example some have long beaks some have short beaks. By averaging this we make an average beak. It means by averaging all things we make a mental representation. What would be a prototype of the concept furniture, average table + chair? The prototype of furniture by averaging of sofa, bed, or chair then a different thing will become.

We store information about categories in a head in the form of prototype is a problematic. The averages of all birds will not be representative.

If we average the feature off all things we nothing find something proper. Like the average of eagle and crow will be different than the actual.

Exemplars

Concepts are represented by exemplars. For example when we close our eyes and think about a bird then a typical bird such as sparrow is recalled.

And when we think about furniture we picture a particular part of our homes and see specific sofas, chairs and tables etc".

These all are exemplars. In the above figure we are seeing a sparrow this is an actual bird not an average bird. So in our

mind we see actual pictures not a average picture.

Lesson 35

Memory

Representation of knowledge (continued)

Levels of Categories:

i) Superordinate Category: "It is a large category at the top of the hierarchy." e.g. furniture, tools, vehicles etc.

ii) Basic Level Category: "It is an intermediate category in the middle of the hierarchy." e.g. table, chair, bed, sofa etc.

iii) Subordinate Category: "It is a small category at the bottom of the hierarchy." e.g. lamp, screw-driver, truck etc.

Prototype

Experiment

An experiment was conducted by Rosch & Lackoff in 1970's on prototypes. They collected a lot of evidence for prototypes at the basic level or the subordinate level but not at superordinate level.

Shown picture of a living room chair were:

A piece of furniture (superordinate level)

A chair (basic level)

A living room chair (subordinate level)

Subjects were divided into three groups and were shown a living room chair. One group was asked you will be shown a piece of furniture. And the second group was asked you will be shown a chair or not and the third group was asked you will be shown a living room chair or not. They were assigned different tasks:

Group 1: If you see any furniture press yes.

Group 2: If you see a chair press yes.

Group 3: If you see a living room chair press yes.

Results:

The results showed that subjects were fastest at the basic level category i.e. chair. Chair faster than furniture or living room.

Subjects identify objects at basic level than make an inference regarding superordinate level (chair is a piece of furniture), or classify them at subordinate level by looking for distinguishing features. People look first the category than they decide it is what kind of or level of category.

Conclusion:

It seems that subjects identified objects at the basic level.

What about carpenters?

Experts in an area may be very quick to make subordinate classification.

Experts might be very quick to make subordinate classifications in their area of expertise.

Rosch and Colleagues:

Roch and Colleagues tried to prove that the experts might be very quick to make subordinate classifications in their area of expertise.

Rosch and colleagues (1976) tested Dog experts and bird experts.

Dog Experts and Bird Experts were taken as subjects.

Subjects were shown the color pictures of dogs and sparrows.

They gave these instructions to the Subjects;

i) You will be shown an animal, if you see an animal press the button.

ii) You will be shown either a dog or an animal, if you see a dog press the button.

iii) You will be shown a beagle and a sparrow.

Replicated earlier results when dog experts identified birds and bird experts identified dogs. But in their area of expertise, experts were as fast at the subordinate level as at basic level.

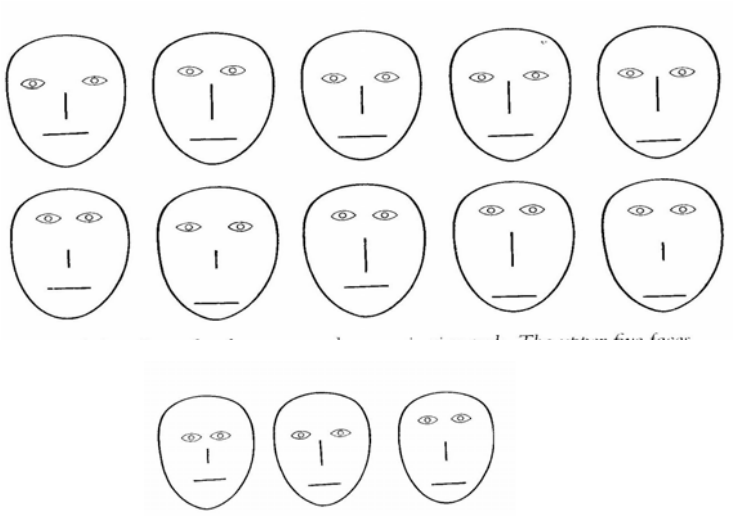
Results:

Dog experts were fastest at the bird condition rather then in the sparrow condition and slow at the animal level. Bird experts were fastest at the animal condition rather then in the beagle condition. Experts were as fast at the subordinate level as at the subordinate level.

The distinction between one level and the other level is a matter of experience rather than the imitation of mind.

Experiments of Stephen Read:

Stephen conducted an experiment by using these faces.



At the top row the faces were named category one and the second row was named the category 2. The last row was called novel faces. After showing the first row and second row subjects were shown a novel face and were asked if this face belonged to category one or category two.

Categorization rules

They developed some rules prior to the experiment. These rules were;

1. Nearest neighbor rule

Matches an item to the test item is called nearest neighbor rule. Subjects compare the novel face with both categories and included this face to the above given categories.

2. Average distance rule

Matches test item on the basis of average similarity is called average distance rule. On the average this face is matched with one category or second category.

3. Prototype rule

Matches prototype with test item is called prototype rule. By averaging all faces subjects make a prototype and then match novel face with this prototype.

4. Feature frequency rule

Selects on Most feature matches is called feature frequency rule. The answers were included in one category according to the frequency.

Results:

58% subjects said that they averaged the features.

Over 50% used prototype.

Over 20% use the feature frequency rule.

Subjects were shown 25 novel faces.

Conclusion:

Prototype strategy was the most frequently used strategy.

Feature frequency rule was the second best.

Average similarity and near neighbor rule were least frequently used.

There might have been other ways of looking at the same problem.

There is also evidence for exemplar and feature frequency rule.

Different rules are applicable in different situations. We all have a tendency to apply these four rules. People selectively use these rules in different situations.

Findings

Prototype most frequent

Feature frequency second best

Some people did use exemplar

Exemplars

Exemplar is not our tendency to match an object with every single item, with every single object in the category. We only match it with a typical item in the category.

Experiments

Nosofsky (1991) replicated his experiment on read experiment. And he found many students use exemplars in classification. He found that many subjects were using exemplar not the prototype.

JD Smith and JP Minda (1998) conducted experiment and they came up with a new idea that is prototype for early learning. When children see goat first time and he says bowh bowh child thinks it is dog. So in early learning the children compare the goat with dog. Probably we use something like prototype in our early learning. We may need more integration rather argumentation.

Lesson 36

Memory

Representation of knowledge (Continued)

Schema Theory

Schema:

Schema is a Greek word which means frame.

A general knowledge structure that provides a framework for organizing clusters of knowledge. When representing the knowledge we have about various categories, it is useful to be able to encode the information that certain features are typical of a category while others are not. Schemas are organized sets of facts. Subjects use schemas to infer that certain unobserved and unmentioned elements must be present. It seems that schemas are a major mechanism for elaborating material during study, and are also the major mechanism for reconstructing memories at test.

Schema Theory refers to a collection of models presuming that we encode such knowledge clusters into memory and use them to comprehend and store our experiences.

A European Solution

While Psychologists in US were busy developing Stimulus-Response Theories, Bartlett in England and Piaget in Switzerland were arguing that behavior is influenced by large units of knowledge organized into schemas.

Bartlett's Schema Theory

Bartlett (1932) conducted an experiment for getting evidence for the role of schemas in memory. He used a story called "The War of the Ghosts". It has been used in research on many subsequent occasions and is still a popular research item today. Bartlett was interested in how the subjects would remember a story that fit in so poorly with their cultural schemas. He had subjects recall the story after various delays. Bartlett's subjects showed clear distortions in their memory for the story and these distortions appeared to grow with time.

Subjects were distorting the story to fit with their own cultural stereotypes. So he found when subjects read a story that does not fit with their own schemas, they will exhibit a powerful tendency to distort the story to make it fit.

According to the Bartlett, Schema is an active organization of past experiences in which the mind abstracts a general cognitive structure to represent many particular instances of those experiences. It means all past experience are organized actively in mind. Then we absorb new experiences in our schemas.

A schema provides a knowledge structure for interpreting and encoding aspects of a particular experience. At his time, Bartlett was not taken seriously.

The Rise of Schema Theory

In 1975 a number of prominent scientists argued that schemata/schemas are needed to organize knowledge in artificial intelligence, cognitive psychology, linguistics, and motor performance. A number of psychologists from different fields gave importance on schemas. Artificial intelligence focused on schemas because schemas make knowledge that helps the computer in information. Knowledge structures include all parts of information, for example a bird; it includes beak, flying quality, legs, hair etc. Linguistic psychologist also gave importance to the schemas because schemas help in organizing the linguistic knowledge.

Cognitive psychology was working on atomistic little bit idea at that time then they realized the importance of schemas.

Bartlett's major assumptions were adopted and developed further into a modern schema theory.

Modern Schema Theory

Minsky (1975):

Minsky started the modern schemas theory again, for representing knowledge in Artificial Intelligence Programs. He made many computer programs in which schemas were used. He said mega knowledge structures are very important for computer programs.

Rumelhart (1980):

He said schemas are building blocks of cognition. Like atoms are building blocks of element. Schema is very rich, brave and complex building block of memory.

Schemas provide skeleton structure to be filled out with detailed properties of a particular instance. For example a bird schema of bird includes instances like feathers, beak, or other bird features.

House: A Schema example

The basic insight is that concepts like house are defined by a configuration of features, and each of these features involves specifying a value the object has on some attribute. The schema representation is the way to capture this basic insight. Schemas represent the structure of an object according to a slot structure, where slots specify values that the object has on various attributes. So we have the following partial schema representation of a house:

For instance, our knowledge of what a house is like.

Slots are Values.

House

Superset schema: building a special slot in each schema is its superset schema. In House, it is Building. Building has walls, roof, it is built on the ground etc

Parts: Rooms (living, bed, kitchen, etc.)

Materials: wood, bricks, stone, cement

Function: human dwelling

Shape: rectilinear, triangular

Size: 100-10,000 sqft

Exemplars: images of various houses

Generally these slots are present in all things. Each pair of a slot and a value specifies a typical feature. The fact that houses are typically built of materials like wood and brick does not exclude such possibilities as cardboard.

If the computer program has all these information then it can match the information with your new information.

Generalization hierarchies

Supersets schemas are basically hierarchies' that e saw with semantic networks. In this case of schemas, they are sometimes called generalization hierarchies. These hierarchies provide a lot of information about an object.

Part hierarchy

Schemas have another type of hierarchy, called part hierarchy. Thus, Parts of houses, such as walls and rooms, have their own schema definitions. Stored with schemas for walls and rooms we would find that these have windows and ceilings. Thus, using the part relationships, we would be able to infer that houses have windows and ceilings.

Schemas are designed to facilitate making inferences about the concepts. If we know something a house, we can use the schema definition to infer that it is probably made of wood or brick, and it has walls, windows, and the like. However the inferential processes for schemas must be able to deal with exceptions. It is also necessary to understand the constrains between slots of schemas.

Lesson 37

Memory

Representation of knowledge

Schema Theory

Superset Schemas

A special slot in each schema is its superset schema. In House, it is Building

Building has walls, roof, it is built on the ground etc.

Generalization hierarchies

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Slots Have More Schemas

Part: Rooms

Rooms Schema would ensure that we know about rooms having windows and doors. So the House would have windows by default.

Psychological Reality of Schemas

Brewer & Treyens (1981) provided an interesting demonstration of the effects of schemas in memory inferences.

In that experiment, 30 subjects were brought individually to a room.

They were told it was an office of the experimenter and were asked to wait there. After 35 seconds the experimenter returned and took the subject to a nearby seminar room and subjects were asked to write down everything they could remember about the room. The picture of experimenter office or room is given below;

Experimental Room

Schema in Action

Prediction:

Subjects' recall would be greatly influenced by their schema of what an office contains. Subjects would do well at recalling parts of schema.

Subjects would not do so well at recalling items that are not part of office schema. They should falsify recall things that are part of the typical office but not of this one. This is just the pattern of results that they found.

Results

The results of that experiment were

29 out of 30 recalled Chair, desk, and walls

Only 8 subjects recalled it had a skull

9 subjects recalled it had books which it did not

Memory for location is influenced by the person's schema for that location.

Schemas as a formalized for representing knowledge were developed in the field of artificial intelligence, where they have proven very useful for organizing and reasoning about large and complex knowledge bases. Although Brewer and Treyens indicated that humans have knowledge representations like schemas, it is not clear that human schemas have all only the properties associated with schemas as they are used in artificial intelligence.

Schemas Represent Natural Categories

One of the important features of schemas is that they allow variation in the objects that might fit a particular schema. There are constraints on what typically occupies various slots of a schema, but there are few absolute prohibitions. This suggests that if schemas encode our knowledge about various object categories, we ought to see shading from less typical to more typical members of the category as the features of the members better satisfy the schema constraints.

There is now considerable evidence that natural categories like birds have the kind of structure that would be expected of a schema. Schemas can represent natural categories such as birds. This would help explain the data collected by Rosch or prototypes and exemplars. She had subjects rate the typicality of various members of a category on a 1 to 7 scale, 1 meant very typical and 7 meant very atypical. Subjects rated some members as more typical than other members. In the bird category, robin got an average of 1.1 and chicken rated on 3.8. Murder was rated a very typical crime 1.0 whereas vagrancy was not 5.3. It would also help incorporate propositional information. Schemas don't have boundaries.

Scripts: Event Schemas

It is not just objects and concepts that can be encoded by schemas. It is alos possible to represent events as schemas. That is we can encode our knowledge about stereotypic events, such as going to a movie, according to their parts- for instance, going to the theatre, buying the ticket, buying refreshments, seeing the movie, and returning from the theater. Each of these can be divided into its parts. So, as with object schemas, we have part hierarchies. We also have generalization hierarchies going to a driver in theatre is a special case of going to a movie.

Events are represented by special schemas called *'Scripts'.*

Schank and Abelson (1977) at Yale University have worked extensively on event schemas or scripts. They pointed out that many circumstances involve stereotypic sequences of actions. For instance, people go to the restaurant and the stereotypic aspects of dinning at a restaurant might be (given below), and represent the components of a script for such an occasion.

Going to a restaurant: Entering, Sitting down, Ordering, Eating, Paying the Bill, Exiting

Another example of event schema can be understood by the example of marriage. We know there are different events or things that make difference between marriage and birthday party. Like, at marriage there are colorful clothes, bride, groom, dholak, food (lunch or dinner) etc.

Lesson 38

MEMORY

Representation of knowledge (continued)

Psychological Reality of Scripts

Bower, Black & Turner (1979) reported a series of experiments in which the psychological reality of the script notion was tested. They asked subjects to write down 20 most important events in an episode such as going to a restaurant. With 32 subjects, they failed to get complete agreement on what these events were. No action was listed as part of the episode by all of the subjects. However considerable consensus was reported. Highest agreement level was;

Sit Down, Look at Menu, Order, Eat, Pay Bill, Leave

73 percent reported this sequence.

Memory for stories

Bower et al (1979) went on to show a number of effects of such action scripts on memory for stories. They had subjects study stories that included some but not all of the typical events from a script. Subjects were then asked to recall the stories or to recognize whether various statements came from the story. When recalling stories, subjects reported part of the script that had not been part of the stories. Similarly on recognition task subjects thought they had seen a sentence that was part of the script but not of the story.

Subjects showed a greater recall actual items from the stories or to recognize actual items than to falsify recognize foils not in the stories, despite the distortion in the direction of the general schema.

More memory for stories

In another experiment, these investigators read to subjects stories composed of 12 prototypical actions in an episode. Eight of the actions occurred in their standard temporal position, but four were arranged. Thus, in a restaurant story bill paid in the beginning and menu read at the end. In recalling stories subjects showed a strong tendency to put the events back in the normal and natural order. This experiment serves as another demonstration of the powerful effect of general schemas on memory for stories.

Bartlett (1932)

Bartlett (1932) conducted an experiment for getting evidence for the role of schemas in memory. He used a story called “The War of the Ghosts”. It has been used in research on many subsequent occasions and is still a popular research item today. Bartlett was interested in how the subjects would remember a story that fit in so poorly with their cultural schemas. He had subjects recall the story after various delays. The story was,

The War of the Ghosts

One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: "Maybe this is a war-party". They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said: "What do you think? We wish to take you along. We are going up the river to make war on the people." One of the young men said, "I have no arrows." "Arrows are in the canoe," they said. "I will not go along. I might be killed. My relatives do not know where I have gone. But you," he said, turning to the other, "may go with them." So one of the young men went, but the

other returned home. And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, "Quick, let us go home: that Indian has been hit." Now he thought: "Oh, they are ghosts." He did not feel sick, but they said he had been shot. So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: "Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick." He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried. He was dead.

Results

The results of this experiment were,

Subjects omitted much of the story, changed many of the facts and imported new information. These inaccuracies in memory were not particularly interesting in and of themselves. The important observation is that these inaccuracies were systematic. Subjects distorted the story to fit with own cultural background: hunting seals becomes fishing, canoe becomes boat. So, they found that when subjects read a story that does not fit with their own schemas, they will exhibit a powerful tendency to distort the story to make it fit.

Applications for studying

Numerous manipulations to improve subjects' memory in recalling a long list of items are given below**.** So the applications of studying are given,

Method of Loci

PQ4R Method

Elaborate

Spacing Effect

Encoding variability

Method of Loci

A classical mnemonic technique has its effect by promoting good organization in recall situations. This technique, used extensively in ancient times when speeches were given without written notes, is still used today. Loci are the plural of locus, it means location. Basically, to use the method of loci the individual imagines a fixed path through a familiar area with some fixed locations along the path. The method is:

Write down a list of important things you would like to remember in your examination. Now visualize a path in your neighborhood where you usually walk. Now take an imaginary walk on the path. Take the first item on the list and store it in one of the objects along the path. Do this with all the items. Now take another walk and retrieve items.

For instance, if there were such a path on campus from the bookstore to the library, we might use it. To remember a series of things, we simply mentally walk along the path, associating the objects with the fixed locations. Take an example of a student of history. Student wants to learn the name of previous leaders of Pakistan. Like, Quaid Azam, Allama Iqbal, Liaqat Ali Khan, sir Syed Ahmad Khan, and Sardar Abdurab Nishtar. To associate the Quaid azam with bookstore, and we might imagine Quaid Azam is buying books from this store. To associate the Allama Iqbal with

the record shop, he might imagine Allama Iqbal was listening the Ghazlas while standing this record shop.

Like that we associate the entire list with something that comes in our way. Then to recreate the list, we need only take an imaginary walk down this path, receiving the associations to each location. This technique works well with very much longer lists; we only need more locations. There is evidence that the same loci can be used over and over again in the learning of different lists.

Two important principles underline the effectiveness of the method of loci:

1. the technique imposes organization on an otherwise unorganized list. We are guaranteed that if we follow the mental path at time of recall, we will pass all the locations for which we created associations.
2. Second is that generating connections between the locations and the items forces us to process the material elaborately.

PQ4R Method

This is also an important technique it is consisted on these phases. The PQ4R method drives its name from the six phases these are

Preview
Questions
Read (Answer questions)
Reflect (Link with what you already know)
Recite (Recall)
Review (go through it mentally, answer questions)

Question making is the most important

Elaboration

This method is consisted on

Making diagrams and label them
Making mental maps
Using PQ4R
Trying and explaining it to your little brother or sister.
Writing a paragraph on how you feel about the material.

Spacing Effect & Encoding Variability

Encoding variability
Learn the same material in different rooms
Spacing Effect
Give as much a gap you can between reading and re-reading

Lecture 39

Memory

Representation of knowledge

Applications for studying

Numerous manipulations to improve subjects' memory in recalling a long list of items are given below**.** So the applications of studying are given,

Method of Loci

PQ4R Method

Elaborate

Spacing Effect

Encoding variability

1. Method of Loci

A classical mnemonic technique has its effect by promoting good organization in recall situations. This technique, used extensively in ancient times when speeches were given without written notes, is still used today. Loci are the plural of locus, it means location. Basically, to use the method of loci the individual imagines a fixed path through a familiar area with some fixed locations along the path.

2. PQ4R Method

This is also an important technique. The PQ4R method drives its name from the six phases it advocates for studying a chapter in a textbook:

Preview

Survey the chapter to determine the general topics being discussed. Identify the sections to be read as units. Apply the next four steps to each section. For example, when starting a new book, skim it quickly. Look at some pictures or diagrams. Study the table of contents. When starting a new chapter, look at different headings. Create a rough idea of what this chapter is about.

Questions

Make up questions about the section. Often, transforming section headings, simply, results in adequate questions. For example, make questions based on headings. Icon: what is an icon? How is it defined? Attention: How does attention link with the Icon? How is Echo different from Icon? How is it similar?

Read

Read the section carefully, trying to answer the questions you have made up about it. You can always modify your questions in the light of what you have read. Interact with the text as you read it. Make it an active exercise not a passive one.

Reflect

Reflect on the text as you are reading it trying to understand it, to think of examples and to relate the material to prior knowledge. How is it going to help? What are the possible applications of the material?

Recite

After finishing a section, try to recall the information contained in it. Try answering the questions you made up for the section. If you can not recall enough, reread the portions you had trouble remembering. Recall the text as you try to answer your own questions mentally. Notice any part you remember better than others. Have another look at the material not yet learned. Try and recall it.

Review

After you have finished the chapter, go through it mentally, recalling its points. Again try answering the questions you made up. Have another look at the text. See if all the questions have been answered. See if there is additional important information to be remembered. Examine your notes and compare these with the text.

One of the reasons for the success of this kind of this technique is that all the passes through the material serve as spaced study the way the material is organized. So, organization leads to good memory, especially on free type tests.

The central feature of the PQ4R technique however is the question generation and question-answering characteristics. There is reason to suspect that the most important aspect of this feature is that it encourages deeper or more elaborative processing of the text the material.

3. Elaboration

This method is similar to the PQ4R method. After studying the material through PQ4R method then elaborate it. Then try to making diagrams and label them according to the materials. Then you can also make mental maps. Mental maps help the meaning clear. It also tells us about the links between the materials. Then students can use PQ4R method. You can also try and explain it to your little brother or sister. During explaining the material to your little brother and sister you will become clearer. You can also explain the material to your other friends of other fields. Then you write a paragraph on how you feel about the material.

The research reviewed indicates that the elaborative conception is more accurate. Subjects elaborate the information they study with the following:

1. Connections to prior knowledge
2. Imaging's and inferences about the material
3. Features from the current context

The evidence indicates that this process of elaboration leads to improved memory in the following ways:

1. It increases the redundancy of interconnections among the-to be remembered information.
2. It imposes an organization on the information that can be used to guide the retrieval process.
3. It can increase the number of contextual elements that will overlap between study and test.

4 . Encoding variability

This is a way in which context influences memory. It is referred encoding effects because the contexts affecting what is encoded into the memory trace that records the event. Learn the same material in different rooms. Try and change places, positions and contexts. Research evidence points to need for variety of situation.

5. Spacing effect

Give as much a gap you can between reading and re-reading. This does not mean do not review immediately. First review material soon. Then re-read material closer to exam. Give as much a gap you can between reading and re-reading. This does not mean do not review immediately. First review material soon. Then, re-read the material closer to the exam.

The spacing effect is an extremely robust and powerful phenomenon, and it has been repeatedly shown with many kinds of material. Spacing effects have been demonstrated in free recall, in cued recall of paired associates, in the recall of sentences, and in the recall of text material. It is important to note that these spacing results do generalize to textbook materials. Also the effect of spaced study can be very long-lasting.

Speed Reading

Speed Reading can help you read fast. But material is not retained well.

But if you are trying to learn new material you are reading stories then it's OK.But then again, its no way to appreciate poetry or literature. It is like that you are drinking tea very fast and burn your tong. So it is not accurate. We must avoid it.

Lecture 40

Memory

Study Methods

It is one area where you can apply all the knowledge that we require the cognitive psychology based on the experimental research and the all different models have been come out and use it to the advantage. So it is very important in almost every field and it is developing rapidly. So the important methods are;

1 Method of Loci

2 PQ4R Method

3 Elaborate

4 Spacing Effect

5 Encoding variability

Analyze Story Structure

When you are studying a story you must analyze its structure. You must analyze its:

Setting: Time and Place

Theme: main goals of characters.

Plot: sequence of events related to achieving goals in the narrative.

Resolution: The outcome of events

Causal relations

Use Multiple Modalities

Another important thing is learn by using multiple modalities. You must store information visually and verbally. Try and learn the information in different ways. No or minimal interference in Short Term Memory between one source and another.

Mental Imagery

Many times when we are thinking about a scene an object no longer present, we experience an image of that scene or object. People often refer to this as "Seeing in one's mind". The important question in mental imagery is,

What is the nature of knowledge representations that underlie mental imagery?

These representations are called mental images. Much of this research has been concerned with the types of mental processes that can be performed on spatial images.

Analog versus Digital

Analog and digital representation is also very important debate in mental imagery as well. Analog representation is a representation of anything in same form. But in digital representation we see and imagine the thing in parts.

Mental Rotation

Shepard and Metzler's (1971) experiment

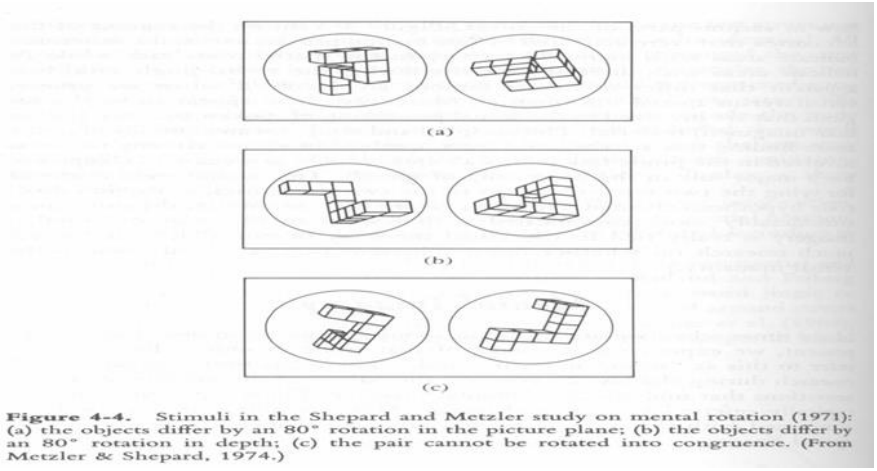
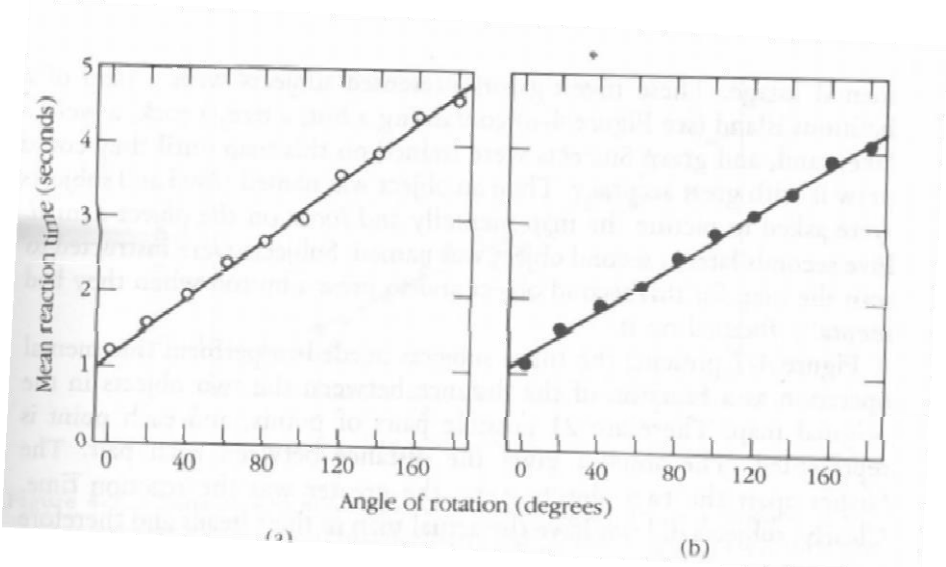


Figure 4-4. Stimuli in the Shepard and Metzler study on mental rotation (1971): (a) the objects differ by an 80° rotation in the picture plane; (b) the objects differ by an 80° rotation in depth; (c) the pair cannot be rotated into congruence. (From Metzler & Shepard, 1974.)

Shepard and Metzler (1971) conducted an experiment. In that subject the subjects were presented with pairs of two dimensional representations of three dimensional objects like those in above figure. Their task was to determine if the objects were identical except for orientation. The two figures in parts (a) and (b) are identical; they are just presented at different orientations. Subjects report that to match the two shapes they rotated one of the objects in each pair mentally until it was congruent one object so that it is identical with the other.

Results



The results are shown in this graph

The graphs in above figures show the time required for subjects to decide that the members of pairs such as those in figures (a) and (b) were identical. The reaction times are plotted as a function of the angular disparity between the two objects presented to the subject. This angular

disparity between the two objects represents the amount one object would have to be rotated in order to match the other object in orientation.

These data might seem to indicate that subjects rotate the object in a three-dimensional space within their heads. The greater the angle of disparity between the two objects, the longer subjects takes to complete the rotation. Of course, subjects are not actually rotating an object in their heads. However, whatever the actual mental process is, it appears to be analogous to physical rotation.

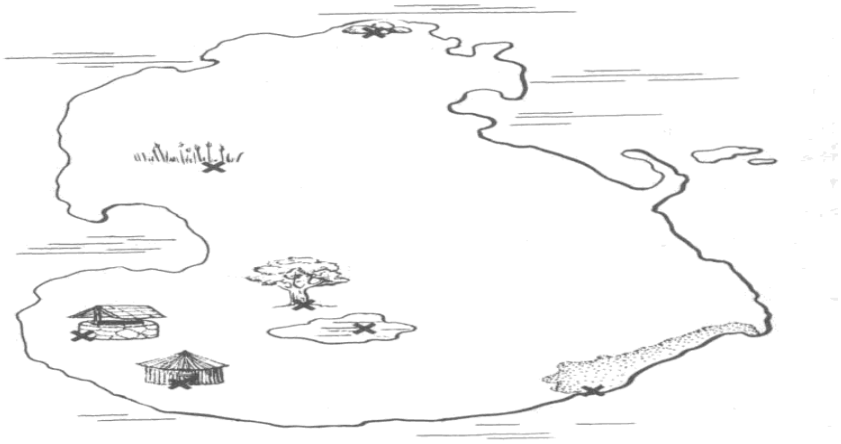
Steve Kosslyn

He worked a lot in imagery. He gave many theories and models. He wrote many books on mental imagery. One of his books is "Ghosts in the Mind's Machine' that is for layman.

Image Scanning

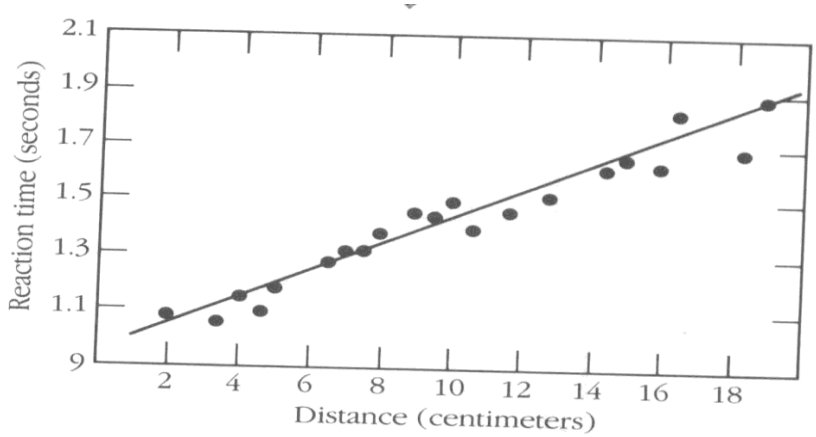
Researchers have looked at a number of other tasks which seem to show that when subjects are performing certain mental computations they are operating on a visual image the way a person might perform continuous operations on a physical object.

An experiment by Kosslyn, Ball & Reiser (1978) shows that it takes time to scan between two locations on a mental image. These investigators presented subjects with a map of a factious island containing a hut, rock, grass, tree, well, lake, sand. Subjects were trained till could draw it with great accuracy. Then asked to picture the map mentally and focus on named object. 5 sec later another object named, scan the map for this object and. Press a button when they find it. The figure is given below.



Results

This graph is presenting the times needed to perform this mental operation as a function of the distance between the two objects in the original map. There are 21 possible pairs of points, and each point is



represented. The abscissa gives the distance between each pair. The farther apart the two objects were, the greater was the reaction time. Clearly, subjects did not have the actual map in their heads and there fore were not moving from one location in their heads to a second location. However, they were going through a process analogous to this physical operation.

Kosslyn (again)

Kosslyn (1995) wrote a book and he said we do have proves of images, is it possible the images are actually stored in the form of propositional knowledge?

Can a propositional theory that can represent all types of knowledge?

The criticism of people on Kosslyn is that what about demand characteristics of the task. Demand characteristics means Subjects try to guess what the experimenter tries to do in the experiment and what he wants to draw. And the subjects perform in the way of experimenter.

Kosslyn answered the criticism by talking about neuroscience. He said the changes in brain actually help us. They don't involve in demand characteristics.

The Evidence

Farah (1988) has made the suggestion that there might be two kinds of imagery, one that involves visual properties and one that involves spatial properties. Farah argues that these same cortical regions are used in imagery tasks that do not involve any external stimuli. They argue that imagery tasks which involve spatial judgments will be performed in the parietal tasks that require access to visual details will be performed in the temporal region and will show modality specific effects. Visual imagery uses the same brain areas as vision. Selective damage to the brain impairs visual imagery in the same manner that it impairs vision. Like Cerebral Blood Flow, Event Related Potential (ERPs)

Occipital lobes are primary & secondary visual cortex.

Imagery and Athletes

Russian psychologist Gregory Raiport (1972-1976) trained athletes to perform mental rehearsals. Good performance needs practice. But in every situation practice is not possible and physical practice also have limit. Gregory worked on imagery with athletes to increase their performance. The athletes are taught to imagine or visualize them selves performing the different stages of the event. They found that neuromuscular practice is very beneficial and valuable for athletes. Athletes should store moving images in their minds.

Lecture 41

Memory

Mental Imagery

Images are tools of thinking.

Many times when we are thinking about a scene an object no longer present, we experience an image of that scene or object. People often refer to this as "Seeing in one's mind". The important question in mental imagery is,

What is the nature of knowledge representations that underlie mental imagery?

These representations are called mental images. Much of this research has been concerned with the types of mental processes that can be performed on spatial images.

More evidence

A very different sort of data for the difference between spatial and linear representations comes from the research of Roland & Friberg (1985). They had subjects either mentally rehearse a word jingle or mentally rehearse finding their way from their house and around streets in their neighborhood.

They measured changes in blood flow in various parts of the cortex. It is apparent that different neural regions are involved when we process verbal versus spatial information. Moreover these appear to be the regions that are involved in the actual processing of spoken and seen material. The occipital and temporal areas involved in the route finding task are the same areas involved in vision. They gave these three tasks, mental arithmetic, memory scanning of a musical jingle, imaging a walk. And they concluded that visual cortex increase in blood flow but not for mental arithmetic or music

Goldenberg and colleagues (1987)

Subjects learned words by either listening to them or forming visual images to represent them. Recall was better for imagery group. More blood flow to occipital lobe for imagery group. Occipital has lot of vision areas.

Kosslyn yet again

He mentioned in his book 'Image and the Brain" at The Resolution of the Imagery Debate (1994) that Visual Buffer is where the image is projected. Attention window selects part of image in the buffer for detailed processing. When we recall the image and realize it is decided by attention window.

Image Comparison

Moyer in 1973 conducted an experiment. He was interested in they speed with which subjects could judge the relative size of two months animals from the memory. For example, which is bigger lion or Wolf? Which is bigger lion or mouse? Many people report that in making these judgments, particularly for the items that are similar in size, they experience images of the two objects and seem to compare the size of the objects in their image. Moyer also asked to estimate the absolute size of these animals

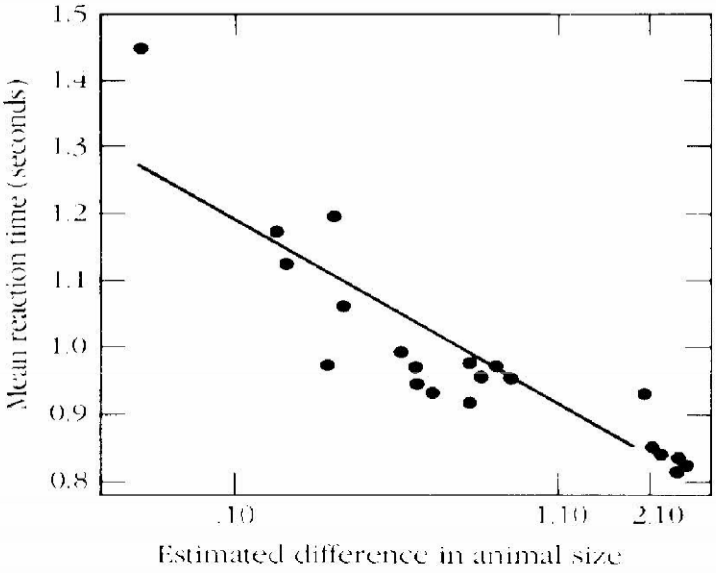


Figure 4-10. Results from Moyer (1973): Mean time to judge which of two animals is larger as a function of the estimated difference in size of the two animals. The difference measure is plotted on the abscissa in a logarithmic scale.

Results

He plotted the reaction time for making a mental-size-comparison judgment between two animals as a function of the difference between the two animal estimated sizes. In general, the judgment times decrease as the difference in estimated size increases. The graph shows that a fairly linear relation exists between the scale on the abscissa and the scale on the ordinate. Thus, the linear relationship in the figure means that increasing the size difference has a diminishing effect on reaction time.

Visual comparison

Line comparison

Significantly very similar results are obtained when subjects make comparisons of actual physical magnitudes. Johnson (1939) had subjects judge which of two simultaneously presented lines were longer.

Results

The graphs plot subjects' judgment time as a function of the log difference in the line length. Again a linear relation is obtained. It is reasonable to except perceptual judgments to take longer

the more similar the quantities being compared are, since discriminating accurately is more difficult in such circumstances. The fact that similar functions are obtained when mental objects are compared indicates that making mental comparison involves difficulties of discrimination similar to those involved in perceptual comparisons.

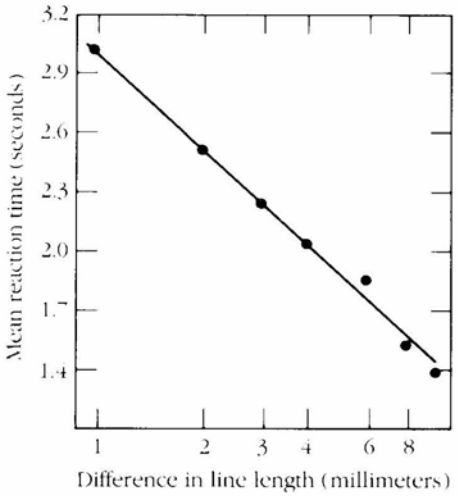


Figure 4-11. Results from Johnson (1939): Mean time to judge which of two lines is longer as a function of the difference in line length. The difference measure is plotted on the abscissa in a logarithmic scale.

Hierarchical Structure of images

Complex images tend to be organized into pieces where each piece represents part of the whole structure. Reed (1974) showed subject complex images and asked them to hold images of the forms in their minds. Then the form was removed and they were showed parts of the image to see if they would recognize them.

Subjects were able to identify forms (b) and (c) as parts of form (a) 65 percent of the item but were successful with form (d) only 10 percent of the time. The reason for the difference was that subject's image of form (a) consisted of parts such a forms (b) and (c) but not form (d).

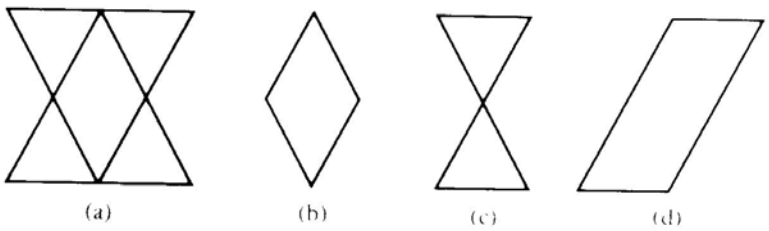


Figure 4-12. Forms used by Reed in his studies concerning the components of images. Forms (b), (c) and (d) are all contained in form (a). However, subjects appear to see forms (b) and (c) as part of form (a) more easily than they can see form (d) as part of form (a). (From Reed, 1974.)

Complex images can be formed from a hierarchy of a unit.

Mental Maps

Subjects' memory for maps appears to have the hierarchical structure associated with spatial images. Consider your mental map of the map of United States. It is probably divided into regions, and these regions into states, and cities are presumably pinpointed within the states.

Stevens and Coupe were able to demonstrate an experiment. There were imagery Alpha and Beta Counties, X and Y cities. Is X east or west of Y? is X north or south of Y?.

Subjects were in error 18 percent of the time on the X-Y question for the congruent maps and 15 percent for the homogenous maps, but they were in error 45 percent of the time for the

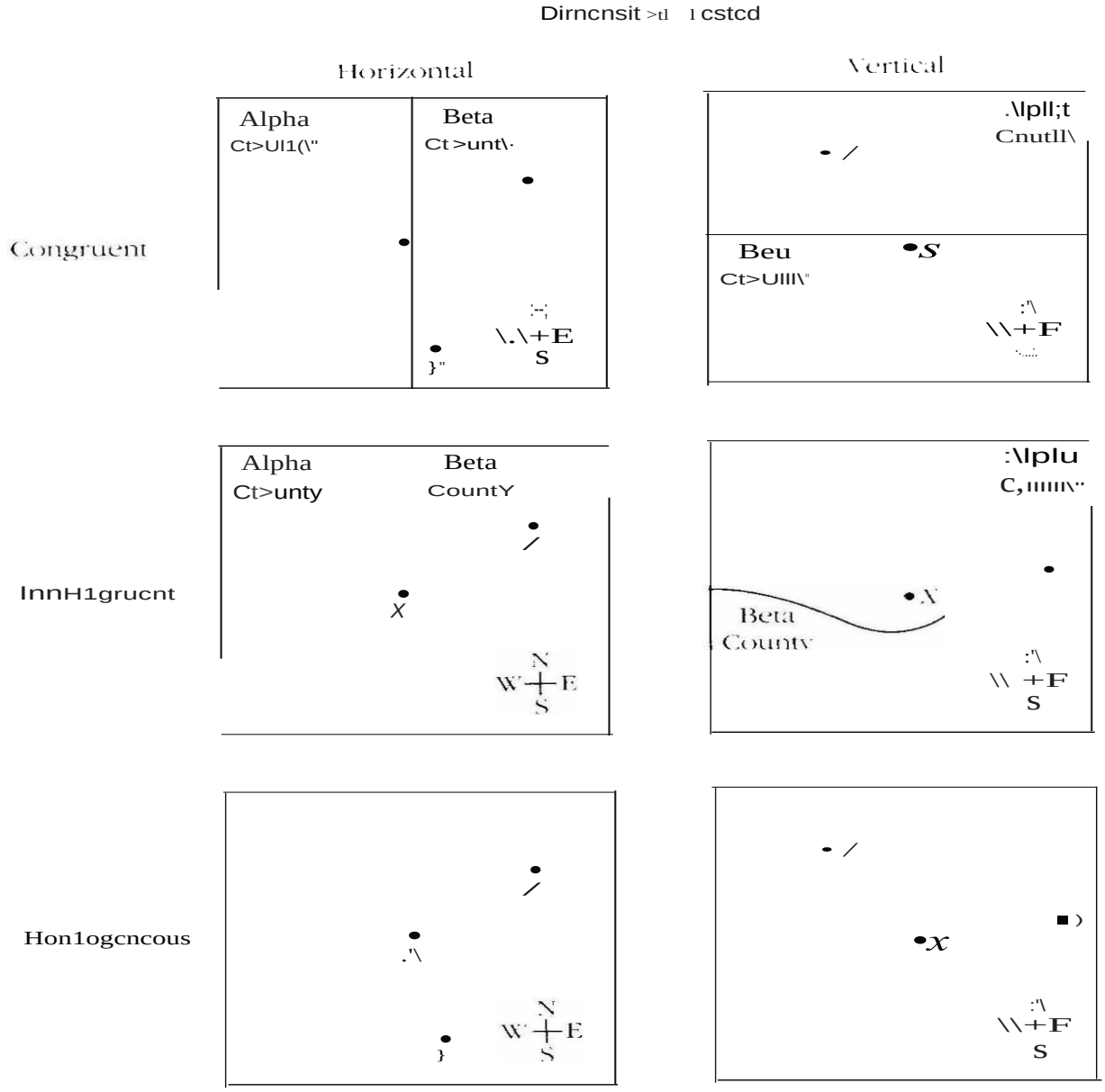


Figure 4-14. Maps studied by subjects in the experiments of Stevens and Coupe (1978), vvhich dernonstrated the effects of ..higher order" infonnation (location of county lines) on subjects' recall of city locations.

incongruent maps. The figure is given below.

Subjects were using information about the location of the counties to help them remember the city locations. This reliance on higher order information led them to make errors; just as similar reasoning can be lead errors in questions about North American geography.

An image can not be a picture but the distinctions between them can be frustratingly subtle. We can perform operations on images, such as scanning, which we also can on pictures. However, it appears that there may be two image systems, one that contains the continuasouly varying and the one that contains the spatial information.

Two types of imagery

Research such as that just reviewed lends support to the view that imagery is spatial but not visual in character. Farah and colleagues (1988) have made suggestion that there might be two kinds of imagery, one that involves visual properties and one that involves spatial properties.

Two types are:

Visual properties

Visual properties involve recognition of visual objects and patterns seemed to be performed in the temporal lobe.

Spatial properties

Spatial tasks such as location. They argued that imagery tasks that require access to visual details will be performed in the temporal region and will show modality specific effects.

Evidence

They gave some evidence that;

Patient with temporal damage
Problems with color
Problems with sizes
Problems with shapes

The patients were OK with mental rotation, with image scanning, and with locations.

Size and detail

Some psychologists wanted to know whether the image size can be changed because of visual screen. In there experiment, Subjects were asked to picture an elephant. Then asked to picture a rabbit next to the elephant. Later subjects were asked to picture a rabbit standing next to a fly. Subjects took longer to see the features in a rabbit standing next to the elephant than on the on standing next to a fly.

Implications

Our Mind's screen is somewhat similar to a TV screen in that it has a limited capacity. If a large elephant fills the screen than the rabbit's image has to be small for it to be accommodated next to the elephant. When the rabbit is next to the fly, the screen is available for a large rabbit.

More on size and detail

Next group was asked to picture a giant rabbit standing next to a tiny elephant. And then they were showed a tiny rabbit standing next to a giant fly. This time they took longer to report features on rabbit next to the fly. This was done to ensure that subjective differences in images are accounted for.

Implications

This seems to confirm the idea that images are screened in a similar fashion to TV or cinema screens for that matter.

People are different

Some psychologist say there is no imagery but some say images are present.

Sir Francis Galton (Darwin's cousin) worked on imagery. In 1883 he asked people to describe various features of their breakfast table. He found that a large number of people reported no imagery. These people were professional and intelligent.

The result of Galton was challenged. And a study published in 1965 tested Mensa members. 97% reported vivid imagery.

Imagers vs. verbalizers

Images and linguistic things are very different.

Visual imagers show more regular breathing patterns than verbalizers when working out problems. This could be because verbalizers use sub vocal speech.

But there is not much breathing in vision.

Imagery is not simple

It may be simplistic to assume that imagery is either present or absent. Some people may be better than others in using imagery for recall. Others may be able to better manipulate images to solve problems. Yet others may be better than others to generate new images for creative purposes.

Eidetic Imagery

Eidetic Imagery refers to people's ability to see an image that is a perfect representation. If you see a picture of a room with 12 chairs but you didn't count them at the time. Asked to look at the image of the room and count the chairs in it, those with eidetic imagery can do a perfect count. Anees A. Shaikh, a Pakistani psychologist in the USA has done a lot of pioneering work on eidetic images

Lecture 42

Mental Imagery

Many times when we are thinking about a scene an object no longer present, we experience an image of that scene or object. People often refer to this as "Seeing in one's mind". The important question in mental imagery is,

What is the nature of knowledge representations that underlie mental imagery?

These representations are called mental images. Much of this research has been concerned with the types of mental processes that can be performed on spatial images. Images are tools of thinking.

People are different in imagery some has very good imagery some don't have proper imagery.

Eidetic Imagery

Eidetic Imagery refers to people's ability to see an image that is a perfect representation. If you see a picture of a room with 12 chairs but you didn't count them at the time. And you asked to look at the image of the room and count the chairs in it, those with eidetic imagery can do a perfect count. Some have good eidetic imagery but some don't have. Like in an experiment in previous lecture, that was conducted by Brewer & Treyens (1981). They provided an interesting demonstration of the effects of schemas in memory inferences. In that experiment, 30 subjects were brought individually to a room.

They were told it was an office of the experimenter and were asked to wait there. After 35 seconds the experimenter returned and took the subject to a nearby seminar room and subjects were asked to write down everything they could remember about the room. Subjects would not do so well at recalling items that are not part of office schema. They should falsify recall things that are part of the typical office but not of this one. This is just the pattern of results that they found.

This experiment was also illustrating the eidetic imagery.

Anees A. Shaikh, a Pakistani psychologist in the USA has done a lot of pioneering work on eidetic images. He did his PhD from USA. He said eidetic imagery can be developed. Dr. Akhtar Ahsen also did PhD from USA and PU. He developed psychotherapy on eidetic imagery.

Eidetic Therapy

Akhtar Ahsen, Pakistani psychologist based in New York has developed a psychotherapy that relies on eidetic images. Ahsen suggests that images are inextricably linked with memories. To release the negative effects of our childhood memories he makes patients recall images of parents that are associated with these unpleasant memories.

If we want to recall an event of our childhood we can do it. We also think what I was wearing and my parents were wearing at that time, what was the location, what was the expression on our parents face. According to Akhtar we can recall it easily. He says childhood experiences must be released from our memories. Because they are negative and unpleasant memories and they can create problem in our life.

Eidetic Psychotherapy

Dr. Akhtar use a term ISM. It means Image, somatic component, Meaning.

Ahsen hypothesizes that each memory has an imagery component, a somatic or bodily component and an interpretation or meaning associated with it.

By manipulating the image one can affect both bodily function and the meaning associated with it. It is a powerful therapeutic technique.

For example, you close your eyes and think about a very beautiful garden or island. Think there are many flowers, there is a beautiful lake, and there is greenery at every where. This thinking gives you a pleasant effect.

So, through all these we can release our problematic emotions. Because when we recall our problematic events we can find their meanings again and we can understand it.

Hot and cold imagery

Ahsen also makes a link with the kinesthetic sense and imagery, especially the temperature sensors in our nervous system. Hot and cold imagery can help relieve long standing mental complaints. Ahsen claims that through hot and cold imagery we can even manipulate our physical sensations of hot and cold. It is very strong claim.

Experiment

Assume the winter season and you are sitting in a cold room, close your eyes and picture a hot fire. You are sitting next to it and feeling quite warm. So warm that you take off the sweater. You are still sweating.

Do this for half a minute. And open your eyes. Do you notice a change in how you feel?

You will feel hot even a slight. You will feel temperature sensation. Some feel more and some feel a bit because the people are different in many things.

The childhood experiences are more eidetic according to the Dr. Ahsen. He says visual image is most important.

Imagery is also be used in psychotherapy. It is very important aspect in treatment.

Examples of the importance of imagery or images:

If i say who Aristotle was think about him. Some can not give answer, some will say he was a Greek philosopher, some will say he wrote many book. While you will be thinking about Aristotle you will think his image as well. Some think just outline, some will imagine his dress and flowers crown as well. Some will think him with beard. So the image will be vague or unclear.

When we read old stories and novels, we also imagine all situations in our mind.

But the image is unclear and vague. The physical image that we make in our mind is always vague.

So, the image is possible in every case. We can also think about the religious people. God does not ban in image making in inside. Like in many Hadiths, there are evidences of dreams. Dreams are also images.

Albert Einstein discovered $E=mc^2$. The question is how he discovered this thing. Einstein explained it he made images about the temperature, energy etc. so images are very important. In all important discoveries the mental imagery is very important. It helps in every field to create new things.

For example, Isaac Newton discovered the gravity force. When he was sitting in his garden and think why the apple fall in ground not up. He thought and made many images of falling apple and discovered the gravity force.

There is a suggestion imagery plays a very important role in discoveries. In the discoveries of DNA, biologist thought about the ladder (helix ladder) and thought the structure of DNA is same like that. So, the images are one of the very important aspects of the study of human mind.

Lesson 43

Language and thought

Another important field is Psycholinguistics that studies the importance of languages in Psychology.

Language

Language is the most impressive of all cognition. The difference between human language and the natural communication systems of other species is enormous. More than anything else, language is responsible for the current advanced state of human civilization. It is principal means by which knowledge is recorded and transmitted across generations. Language is far superior to animal communication.

Languages also provide people with the principal means of assessing what another person knows. So, without language human beings would experience countless more misunderstanding than they currently do. If there were no language people will be bored by technology so, there will be little technology without language. Therefore without language much of the joy of living would be lost. Language is very important in every field i.e. Religion, Law and Morality.

Language is a primary source of cognitive psychology. Noam Chomsky made language his basic subject matter and talked about the importance of language. He also criticized Behaviorists that gave importance only to the overt behavior and ignored the importance of language.

Productivity & Regularity

Language is not a random combination of words. Balanced against the productivity of language is its highly regular character. The psycholinguist focuses on two aspects of language: productivity and regularity.

Productivity refers to the fact that an infinite number of utterances are possible in any language. Regularity refers to the fact that these utterances are systematic in many ways.

A set of rules that accounts for both productivity and regularity of natural language is called grammar.

What is Grammar?

A grammar should be able to prescribe or generate all the acceptable sentences of a language and be able to reject all the unacceptable sentences in the language.

Some violations of grammar are given below;

1. These are rejecting syntactic violations

The girls hits the boys

The girl hit a boys

The boys were hit the girls

These are called syntactic violations. They are fairly meaningful but contain some mistakes in word combinations or word forms. The correct sentences are

- The girls hit the boys.
- The girl hits a boy.
- The boys hot the girls.

2. Reject semantic violations

Colorless green ideas sleep furiously
Sincerity frightened the cat

These are correct syntactically but wrong semantically. In these sentences words are correct in form and syntactic but their combination is nonsense.

3. Reject phonological violations

Vere is the wase?

We produce V and W same phonologically. These are mistakes V and W have different sounds. This sentence is correct syntactically and semantically but be mispronounced. The correct sentence is where is vase?

To account for the regularity of language, linguists need a grammar. The grammar includes Phonology, Syntax, and Semantics. Phonology means sound, syntax means structure, and semantics means meaning.

Linguistic Intuition

Another feature that linguists want a grammar to explain is the linguistic intuitions of speakers of the language. Linguistic intuitions are judgments about the nature of linguistic utterances or about the relationship between linguistic utterances.

Some examples of linguistic intuition are given in Urdu.

For example,

Larki nay Larkay ko maara

Larkay nay larki say maar khai

Above two sentences are paraphrases Ambiguity: Ambiguity means one word has more meanings that are confusing. For example, they are cooking apples. This sentence has many meanings. Some can think it as cooking as food some can think cooking means making salad etc.

Grammar can specify well-formed sentences, ill-formed ones and why. Explain intuitions that have about such things as paraphrase and ambiguity.

Competence versus performance

Linguistic competence means a person's abstract knowledge of the language. And linguistic performance means the actual application of that knowledge in speaking or listening. In Chomsky views the linguist's task is to develop a theory of competence and the psychologist task is to develop a theory of performance.

Our everyday use of language does not always correspond to the prepositions of linguistic theory. We misunderstand the meaning of sentences. We hear sentences that are ambiguous but do not note their ambiguity. Another complication is that linguistic intuitions are not always clear.

For example, a child talks to his mother and says

Child: Look Mum fis
Mother: Fis?
Child: No, fis.
Mother: Oh, fish.
Child: Yes, fis.

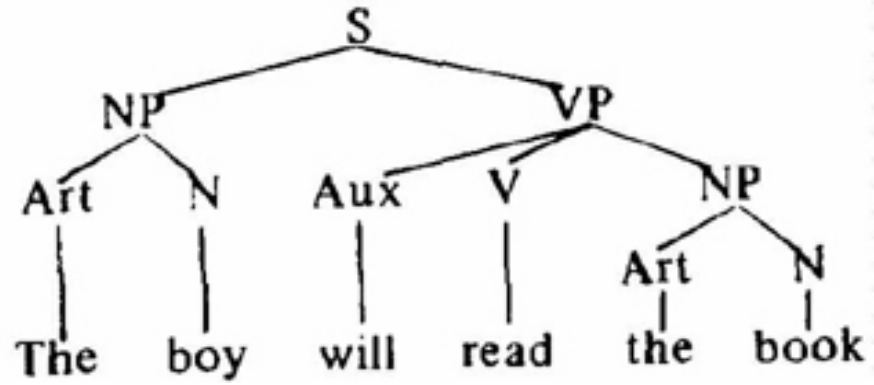
This is the fis phenomenon the child knows but can't perform.

Syntactic Formalisms

A great deal of emphasis in linguistics has been given to understanding the syntax of natural language. One central linguistic concept is phrase structure.

Phrase Structure

Phase structure analysis is not only significant in linguistics, but is also very important to an understanding of language processing.



In the above figure the structure of phrase is given as an upside-down tree. In this phase structure tree sentence (s) points to its subunits nouns phrase (NP) and verb phrase (VP), and each of these units points to its subunits.

Chomsky

Noam Chomsky worked a lot on language. He made some rules of grammar. He says every sentence has two structures.

Deep Structure

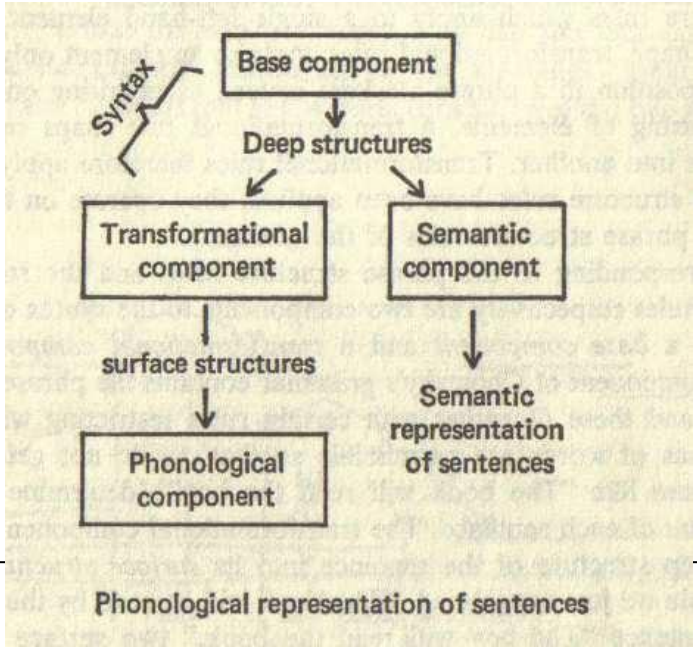
Surface Structure

Then there is Transformational grammar that helps in making sentence.

Deep: The boy reads the book

Surface: The boy +future tense+ read the book. After the transformation the sentence become "The boy will read the book".

The figure, in below, is showing the Chomsky concept of deep structure and surface structure. How the sentence start with the base component then deep structure then transformational component and semantic after these components there is surface structure and in the last there is phonological structure.



Language and Thought

Next question is that what affect the structure of language has on cognition. Language is a source of thinking. A wide variety of proposals have been put forth as to the connection between language and thought.

There are many evidences showed the relationship between language and thought; Aristotle argued that thought determined language 2500 years ago.

Whorf argued in the 20th century Language determines thought. He claimed that language determines or strongly influences the way a person thinks or perceives the world. This proposal claims that language and thought are identical. Arabic has a large number of words for Camel. Eskimos have a large number of words for snow. Their language has any effect on the Eskimos' perception of snow over and above the effect of experience. The difference between ice and snow is also clearly understood by Eskimos than any other person.

Chomsky took a modularity position in this debate of language and thoughts. He said language and thoughts are separate systems that have different process.

One experiment was compared the ability of Dani (people of Indonesia) to learn nonsense names of focal (basic) colors versus nonfocal colors. English speakers find it easier to learn arbitrary names for focal colors. Dani subjects also found it easier to learn arbitrary focal colors than nonfocal colors even they have no names for these colors in their culture.

Natural order

In different languages the sentence order is in these forms

S= subject

O= object

V= verb

SOV 44 percent of worlds language

SVO 35 percent of worlds language

VSO 19 percent of worlds language

VOS 2 percent of worlds language

Lesson 44

Cognitive development

Jean Piaget

Jean Piaget (1970), a Swiss biologist, philosopher, and a Psychologist studied own children in great detail. And eh has developed the most detailed and comprehensive theory of cognitive development. Piaget called his Approach genetic epistemology. Epistemology is the study of the nature and acquisition of knowledge. In Piaget's view, the development of knowledge is the form of adaptation and as such, involves the interplay of two processes:

1. Assimilation

Assimilation means modifying one's environment so that it fits into one's already developed ways of thinking and acting. For example, when a child hoists a banana and runs around in a circle shouting Look- it's a jet. The child is assimilating the banana into ways of thinking and behaving that are already in place.

2. Accommodation

Accommodation means modifying oneself so as to fit in with existing characteristics of the environment. For example the child who, for the first time, manages to peel a banana and adjust hi s mouth so that the banana will fit into it has accommodated his ways of thinking and behaving to the banana as it really is.

Of course, most steps in development involve some blend of assimilation and accommodation.

Stage Theory

Piaget proposed his cognitive development theory that consists of distinct Stages. Piaget focused on the biological maturation of cognitive abilities.

He used the term schemes that are mental structures that guide developing sequences of thinking. For example, when infants suck, they are exercising a sucking scheme, the first sucking is primitive and not very flexible in style, and they need to adjust the way they hold their mouths so as to fit the object being sucked.

Major Assumptions about the Child

According to the Piaget the major assumptions about child are;

Child constructs his own reality. He or she perceives the world in his or her own way.

Child acts on the environment almost like a scientist. He or she is not passive.

Child is naturally curious. Child wants to explore things.

Child's learning is limited by his biological limitations. Biological limitations mean physical problems as well mental problems.

Stages of Development

He proposed 4 development stages.

1. Sensorimotor stage 0-2
2. Preoperational stage 2-7
3. Concrete operational stage 7-11
4. Formal operational stage 11 onwards

1. Sensorimotor Stage

This stage occupies the first two years. During this stage, child develops schemes for thinking about the physical world. For instance he or she develops the notion of an object as permanent thing in the world. That is called object permanence. It means child does not look for disappearing objects. After one year this object permanence develops in child. Object permanence is the idea that objects continue to exist even when we can no longer see them.

Another thing happen in this stage is child picks things up, doesn't let go, and puts them in the mouth. Child does not turn his head. Some critique on this notion is that perhaps child can't turn. Perhaps he doesn't have the concept of "behind".

2. Preoperational Stage

The second stage is characterized as spanning the period from 2 to 7 years.

Symbolic function;

Unlike the younger child, a child in this period can engage in internal thought about the world, but these mental processes are intuitive and lack systematicity. For instance, a 4 year old asked to describe this painting of a farm and some animals said, first over here is a house where animals live. I live in a house. So do my mommy and daddy. This is a horse. I saw horses on TV. Do you have a TV? Piaget explained some limitations of child;

1. Egocentrism

   It means an inability to take the point of view of another person.No perspective taking skills.

2. Animistic thinking

   The belief that inanimate objects which have certain characteristics of living things are, in fact, alive. Child can not learn the cause and effect relationship.

3. Centration

   Child does not have conservation of things.

   Child can now walk and run

3. Concrete Operations

This stage spans the period from 7 to 11 years. In this period children develop a set of mental operations that allow them to treat the physical world in a systematic way. However, children still have major limitations on their capacity to reason formally about the world.

In this period child had developed conservation. Mental Operations are presented in children but no abstract thinking.

4. Formal Operations

The capacity for formal reasoning emerges during Piaget's fourth stage. It spans the years from 11 to 15. After emerging from this period, the child has become an adult conceptually and is capable of scientific reasoning which

In this period thinking becomes abstract thinking. Child also develops his or her perspective taking ability. Child also has developed the deeper moral questions such as Justice, fairness, freedom, equality.

Piaget takes as the paradigm case of mature intellectual functioning.

Critiques of Piaget

Children have developing memory and language skills.

In each stage children can actually do more than Piaget claims.

Children can distinguish between animate and inanimate objects.

Young children can take others' perspective.

Different experiments were conducted to criticize the Piaget's concepts.

For example a set was made, in which a to of police man was placed and on the other side there was a toy of thief was placed and asked children whether the police man can see the thief if there was glass window child said that yes police man can see. When there is board child said police man can not see.

Language Development

Children develop language in these four stages

Children less than 2 years make and use small sentences: From 2 words to longer.

3 Years and onwards children have fully developed language. And they can make and use complete sentences.

5-6 years children have developed amazing level of competence.

Gender Development

Boys are different from birth and they indulge in rough and tumble, aggression. Girls play differently. As boys get older, they become interested in rule based games. As girls get older, they become interested in relationship based games. Boys spend their lives with other boys. Girls spend their time with other girls. And they have brief interruption for dating, courtship and marriage. After the honeymoon period this trend resumes. Boys and girls have trouble in understanding each other.

Lesson 45

Cognitive Development

Gender Identity

By the age 5 boys and girls know their genders are permanent. Before this time, they assume it is their clothes that make them boys or girls. This is called the gender constancy.

Learning Mathematics

Mathematics teaching poses the greatest challenge to teachers. Math has two components: concepts and skill. Concepts have to be understood and skills have to be learnt and practiced. There are four skills: Listening, Speaking, Reading and Writing. Drills are useful for understanding rules. Learning in pairs and groups are also useful.

Learning Science

Science can be taught to the teachers by different ways; Inquiry based teaching, Making children discover, learning by projects, using direct experience, and learning in pairs and groups.

Learning Thinking

Children are not taught how to solve problems. A recent research in Pakistani schools shows that teachers solve problems for children on the board and ask them to copy. Children are not taught how to think.

Overview of all lectures of cognitive Psychology

This lecture will move from sensation to perception, from perception to learning, from learning to memory, from memory to imagery, from imagery to thinking and problem solving, from thought to language and finally to development of cognition.

Cognitive Psychology is about knowing or knowledge. Cognitive Psychology deals with cognition. Cognition can be understood as "thinking" or "knowing." We can say, in other words, that cognitive psychology deals with the processes involved in thinking and acquisition and storage of knowledge. For this purpose it adopts an information processing approach.

The information processing approach looks at how input is transformed into output. In other words, what happens between sensation and behavior is amore important question for cognitive psychologists than just which sensation produced which behavior. Cognitive Psychology treats the sensation as bits of information which are subjected to various processes in the mind and ultimately behavior may or may not result from this.

These processes are usually performed in stages. There are also different layers or levels of processing in each stage. We can talk about these layers as levels of description rather than actual process itself. Human information processing have a hardware level description - such as what happens in the brain or nervous system when a sensation occurs – and a software level description – like when we close our eyes to recall an image of that sensation, how are we able to recall the image. The hardware level description may consist of studying the visual sensation itself.

Step 1: Sensation

First we studied neurons, brain, and the nervous system. A neuron is a specialized cell that transmits and stores information of different kinds. The brain can be divided into four lobes: Occipital lobe, frontal lobe, temporal lobe and parietal lobe. In each lobe are performed certain specialized functions. Then we studied the structure and function of eye and ear, auditory and visual pathways. Visual information passes through the lens of eye which helps focus the image on the retina. The information goes from the retina to the optic nerve which transmits it to the brain. The visual pathway can be simply described as starting from the retina where the image is

formed to the optic nerve. The auditory information in the ear comes in the form of sound waves and impacts the ear drum. From this the information is transmitted via Cochlea to the auditory nerve.

Information processing (of visual information) is done in our visual cortex. Then

Then we studied the different experiment of sensation such as, David Marr and Cat's brain.

At sensation level there are visual cortical cells, Edge and Bar Detectors. Edge detectors help us to understand where an object ends and other starts. Edge detectors respond positively to light on one side of line and negatively to light on the other side. And Bar detectors respond positively to light in the center and negatively to light at the periphery, or vice versa.

Sensory Memory

When information first enters the human system, it is registered in sensory memories**.** Sensory memory allows us to take a snapshot of our environment, and to store this information for a short period. Sensory memory holds a short impression of sensory information even then the sensory system does not send any information anymore. There are 5 basic senses, vision, hearing, smell, taste and touch. There are also The Icon and the Echo. Iconic memory represents visual sensory memory and echoic memory represents auditory memory.

We also studied two paradigms, Whole report versus partial report.

Dichotic listening tasks are also discussed in auditory process.

Different experiments were studied in earlier lectures such as, Neisser, Sperling, Moray, Turvey.

Attention

Attention is conceived of as being a very limited mental resource. Numerous metaphors can help us to think about the limited-resource characteristics of attention**.** Some common metaphors of attention are;

Filter models, capacity models

Adjustable filter models

Limited capacity and bottleneck

We also discussed Attention and Automaticity it means The more a process has been practiced, the less attention it requires, and there is speculation that highly practiced process require no attention at all such highly practiced processes that require little attention are referred to as automatic. Different experiments on attention are the experiments of Treisman, Broadbent, and Norman. In pattern recognition some talked about top down processes and some talked about bottom up processes then there was a new process that called parallel processes that talked about top-down and bottom-up levels.

Working Memory

Short Term or working Memory

Memory that we use to function is called short term memory. Attention is very important in short term working memory. Miller talked about the Magic Number 7 + or – 2, that is easily learn by normal people.

Then we studied decay and interference in short term memory. it means information in Short Term Memory is lost rapidly unless it is preserved through rehearsal. Then we discussed, chunking, spreading activation, executive function, thinking and decision making.

Long Term Memory

A memory that lasts more than 20 seconds is Long term memory.

So if you can recall something after 20 seconds it is in your LTM. Different Kinds of long term memory are;

1. Procedural versus Semantic Memory
2. Episodic Memory

Encoding in LTM is happened and there is a relationship between STM and LTM. Different experiments on this relationship have been conducted and models were presented such as Atkinson & Shiffrin, and Andersen models.

Categories and Concepts

"A category refers to a group of objects sharing the same essential features. And "Concept is a mental representation of a category."

The Classical Views are, Prototypes and Exemplars. Proto means "essential or basics" when we make new things first of all we make a proto that explain briefly the new things. Concepts are represented by exemplars. For example when we close our eyes and think about a bird then a typical bird such as sparrow is recalled.

Then other important things are Schemas and Scripts. Schema is a Greek word which means frame. A general knowledge structure that provides a framework for organizing clusters of knowledge And scripts, that is we can encode our knowledge about stereotypic events, such as going to a movie, according to their parts- for instance, going to the theatre, buying the ticket, buying refreshments, seeing the movie, and returning from the theater.. There are different Study Methods such as, PQ4R and Method of Loci.

Imagery

Images are tools of thinking. Many times when we are thinking about a scene an object no longer present, we experience an image of that scene or object. People often refer to this as "Seeing in one's mind. Farah and colleagues (1988) have made suggestion that there might be two kinds of imagery, one that involves visual properties and one that involves spatial properties. Then we studied different important things in imagery like, rotation, size, detail, and location.

Hierarchical nature of images

Complex images tend to be organized into pieces where each piece represents part of the whole structure.

Eidetic Imagery refers to people's ability to see an image that is a perfect representation. Anees A. Shaikh, a Pakistani psychologist in the USA has done a lot of pioneering work on eidetic images. Akhtar Ahsen also worked on editic imagery. Kosslyn also conducted experiment on mental imagery.

Psycholinguistics

Language and Thought

Grammar: Sound, Structure and Meaning

Universal nature of language

Superiority of human language

Competence versus Performance

Productivity and Regularity

Chomsky

Cognitive Development

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Language Development

Children less than 2 years make and use small sentences: From 2 words to longer.3 Years and onwards children have fully developed language. And they can make and use complete sentences. 5-6 years children have developed amazing level of competence.

Social Development

Children devolo0p their social relationship first from their mothers, siblings and then peers. As the children social world expands to include classmates and teachers, children's ways of thinking about people show a corresponding change.

Gender Differences

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The Approach

By studying all of these in cognitive psychology you can also develop an approach. We all have information processing approach. Its process consists of these steps,

Theorize

Develop a model

Test it through experiments

Test it through computer simulation

Examine Results

Theorize further

And then learn from developments in ICT and AI.