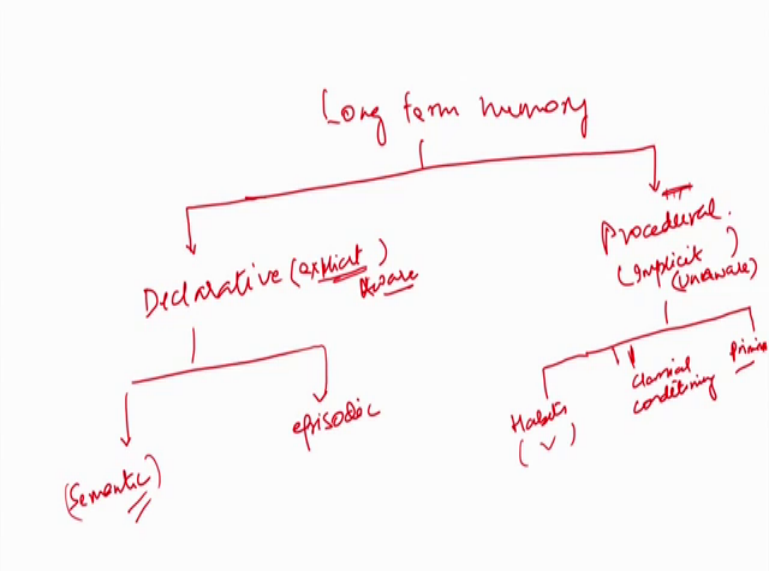
**Introduction to Cognitive Psychology**
**Dr. Naveen Kashyap**
**Department of Huminities and Social Sciences**
**Indian Institute of Technology, Guwahati**

**Lecture – 15**
**Semantic Memory Basics**

Hello friends. Welcome back to this lecture on memory continuing from the last class, we discussing about long term memory. In the upcoming lectures, we will discuss on the types of long term memory which are available for humans and will see; what are the properties of this memory? How do they function and several the qualities of these memories? So, let us begin this lecture on semantic memory. Now, if you remember from the last class, I discussed about the way long term memory is organised and so, what we saw in the last class was that long term memory had two separate distinctions.

(Refer Slide Time: 01:11)




So, two separate parts of it and I also explained a little bit about the distinctions or these 2 parts. So, these parts are the declarative and the procedural type of memories. Now declarative, if you remember from the last class, declarative type memories are those memories which have conscious which have conscious awareness people are consciously aware. So, when performing this memory people know what they doing and so, they basically take part in these memories consciously remember are well aware of what is happening and so, memories of evens memories of facts, memories of other kind of

memories which you know that you are acting on or you are thinking of are declarative in nature. And so, the declarative memories are then divided into two parts also declarative procedural memory can also be sub divided in terms of explicit

So, some books for talk of declarative memories and then explicit memory and the procedural memory as an implicit memory and this explicit implicit is basically dependent on the amount of consciousness that you are putting on to it. So, whether you are aware. So, if you are aware of a particular memory type, it is declarative, if you are unaware of a particular memory when it is functioning, this is the implicit type and so, there is a debate on this two types of memories of declarative and procedural or two memories area..

Now looking at the sub divisions the declarative memory is divided into two sub divisions, we have the semantic memory and we have the episodic memory and so, the upcoming few lectures will be basically focusing on the semantic and the episodic. Now procedural type memory where people are not aware of that they are accessing the memory is basically implicit and basically implicit in nature is something which will not discuss here in this particular introduction 2 cognitive psychology classes, but I will give you the distinction of what types it is further divided into. So, we have habits, we have classical conditioning and we also have priming.

Now, if you look at the earlier lectures, have a briefly defined these habits classical conditioning and priming and what is the meaning of that and also about semantic and episodic. So, quickly look into what it is. So, procedural type memories are those memories which you are not aware of that they exist, but they take place for example, riding a bicycle playing a piano typing on the keyboard and so on and so forth. So, we do it with such less intention that you are not consciously aware, but they are doing it and declarative memories are those were your conscious aware..

So, thinking about a particular event thinking about a particular fact in life verifying a knowledge verifying a rule or several other kind of memories were you are aware of it is what is declarative within the semantic episodic distinction semantic memories are those memories which are based on facts rules knowledge arithmetic properties things about objects facts about objects which you can verify colour shape that kind of a thing is semantic memory..

So, the when I say I know one applies or questions like who was Christopher Columbus or questions like; who is a Donald Trump, where is US, where is Europe or facts like 2 plus 2 equals to 4, what is the meaning of addition sign? What is the meaning of a division sign? What is an in integral? What is an indefinite integral and that kind of facts which have both either arithmetic rules facts in life or facts in knowledge are all semantic in knowledge or semantic in type.

Declarative memories are those memories which we basically go ahead and remember about events. So, your first day of school, your first graduation, the graduation night, the prom night that you had after graduation your first farewell of school, second farewell of course, would have been to 10th and 12th class, both. So, two farewells to think about first day in college, first day in school, any party in your life, all those kinds of events were you are personally aware of or were personally part of is basically, what your episodic memory would consist of ninth procedural type your habits. Habits are those facts which basically are something which happens automatically.

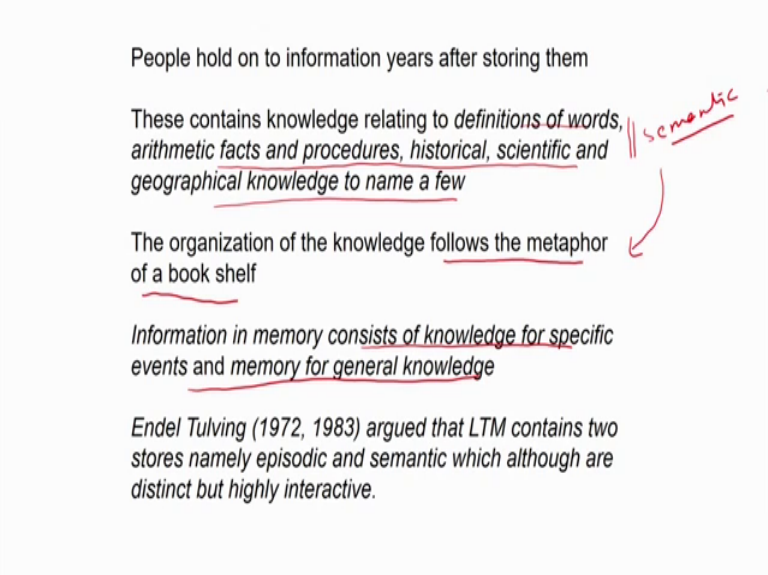
So, habits like habits of scratching yourself habit of touching your hair at age point of time habits of twitching your nose the several habits that people have and these are automatic of kind of things automatic kind of acts that people do, but they are not aware of similarly in classical conditioning; what happens is that doing something not knowing that you are doing that particular act or behaviour for a particular reward is something called classical conditioning. So, buying something because something else is free with it or thinking positively about someone because something has been offered to you for thinking positively about that person is classical conditioning.

In priming brief kind of information or a brief information is presented to you and this information leaves you to basically go ahead an access memory or verify a particular fact. So, before knowing someone, a some kind of information is provided to you very distinctly or very implicitly about this person you are first impression of the person would be change according to it and so, that is what is priming. So, in this particular lecture will be mainly focusing on semantic memory.

So, what will look into is what is semantic memory what are the basic what are the basic steps of formation of semantic memory what are the various tools which I use for accessing it the models which explain it the various underlying limitations of the various

model and what does it explain what does it do for and so on and so forth. So, that is what will be looking in this first lecture. Let us continue with our idea of semantic memory in the next coming lecture, we will also look on a part of episodic memory or visual memory.

(Refer Slide Time: 08:48)




So, then what is obvious to as is that people have a lot of knowledge they hold on to lot of knowledge around this world or about this world with then at each point of time. So, from the time, when you are born to the time to the present time you have a lot of information with you about the world around you about the environment around you what people around you. And so, they are stored in your in your personal memory and most of this information which is stored may be personal and may not be personal image as for example, something which does not concern you facts like where is America does not concern you and so, it is stored and there will be other facts like something about when is your birth date or what is the colour that you like are also stored on to it.

So, a lot of memory is stored or lot of information is stored in your memory of these contains as I said knowledge relating to definitions of words arithmetic facts procedures historical and scientific geographic knowledge and so on and so forth and so, most of these are semantic in nature. So, any memory which is not concerning you or concerning yourself into it or does not form around you is semantic knowledge. So, facts that can be tested facts that can be verified facts that you learn from people around you and facts that

are helpful for you in terms of making you live this world are basically semantic in nature.

Basically, then how is memory arranged what is the way in memory arrange and one of the earliest metaphor or what are the earliest analogue of how memories arranged is basically the book shelf meta metaphor. So, it is and this is are the semantic memory that I am talking about. So, knowledge facts ideas arithmetic properties and all those how are they arranged one of the basic metaphor or one of the primary metaphor is the book shelf. So, basically it is believed that just like when you go to a library how do you search a book.

So, the best way if you have been to a library nowadays there are computer programs like Lipsus which actually help you into finding a book, but if you go to an old library where they do not have this softwares for helping you to how find out, how to locate a book. You would find out that there are still the old methods of finding of book and how is that work.

So, you basically go to particular desk which is called the naming catalogues. So, it could be either a naming catalogue and or a place catalogue. So, naming catalogue would have names of authors and a place catalogue or title catalogue will have titles of authors. So, you choose one of this catalogue and so, let us say I choose the title catalogue or the subject catalogues. So, I choose that let say I choose the naming catalogue.

Now, suppose I am looking for a particular book, I am looking for book Alice in wonderland and so, if I am looking for Alice in wonderland, I will have to search from something called the A. So, I look for A of all the books which are available in A and within A, there will be several variations from a to a, a z, hence of within a a a, you will have several books a b, you will have several books a c, you will have several books and so, when you go through that Alice in wonderland is a a l. So, I will go to a l and then I will search for the particular books. So, within a l you have lots of books. So, I will come to the basic book within that particular book also Alice in wonderland. There will be several versions of it the breech version the main version the total version.

So, I will look at that and then there will be something called a calling number or basically an extension number and I will look at the extension number then I will go to the row the main library where books are in stacked and then I will search for I will look

for the particular extension number because books are arranged according to extension number and look for that particular three digit 4 digit extension number and I will find that version of the book. So, this is basically how the book shelf metaphor really works it is believed that semantic memory also follows a metaphor like this, this is how most items or most facts are in it semantic memory.

So, information in memory they consist of knowledge or specific events and memory for general knowledge as I said this being most information on memory will be either personal or will be either general knowledge thing it is of how general knowledge is facts about general knowledge are stored as a mostly is the follower metaphor which is equal to book shelf now fact theory is that the question that do we have this kind of a distinction in declarative memory now in the last class we saw that there are the debate over existence of procedure even semant declarative memory in this particular lecture will see a debate or we will discuss a debate on the existence of semantic and episodic memory.

So, whether there are 2 kinds of memory and if there are then what is the way in which they arranged and what are the properties. So, in 1972-1983, he argued that LTM contains of two stores, basically the episodic in the semantic store which all which are very highly distinct, they are high distinct stores because one store stores facts knowledge and that kind of a things you do not need you to think about it, think about anything, think about any personal relevance information there and the other store is the declarative store were; I am sorry, the episodic store were you have information which is personal in contend.

So, he argued that these are the 2 kind of store on interesting fact here the fact is that the episodic store cannot exist without the semantic store. So, some kind of information is all always borrowed from the semantic store and when we end this section will also talk about something called scripts and schemas as schemas and scripts are the way of how the semantic store interferes or basically aids the episodic store.

Now, the episodic store I think of the episodic store when I am thinking about the particular party or a particular your graduation night thinking about your graduation night if that is what I am think about it has a lot of information and to it, but information follows a certain rule or follows a certain structure and this structure is. So, when you

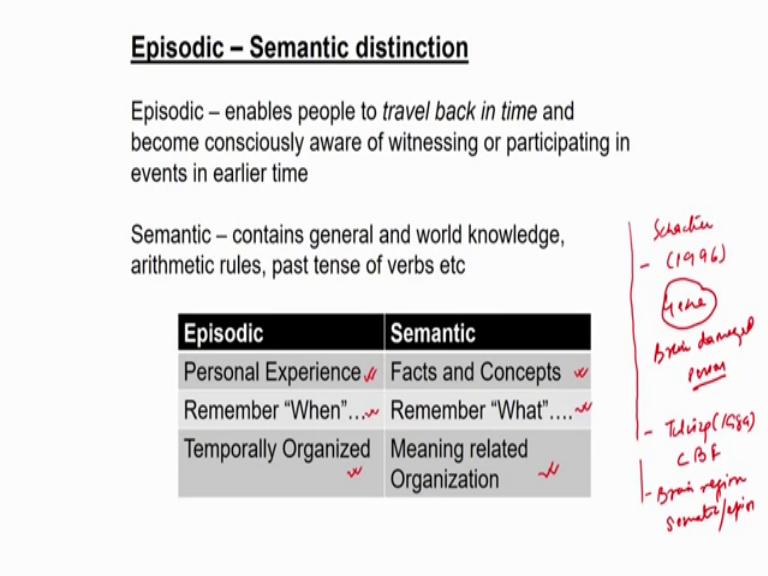
think of about party you think about a routine what happens in a party that is what basically scripts are scripts are schema of a its a basically a schema for routines we will come to that.

So, basically there are certain steps for party and that is what you tend to remember in that particular way you tend to remember. So, although the facts may vary from person to person, but graduation night the what happens in a graduation night would be similar to most people and that is what a script is all about and the idea that this is what happens in a graduation night you go there you do something you do a little bit of dancing lot of chatting mister and mistress miss graduation is named, then you drink the punch or whatever you do have a lot of fun and may be dance with a lady and then you come back and this is the kind of schema which is there or this is the kind of structure of graduation party which is there and so, this is what is going to happen and this is what happens in a particular schema in a in a particular event and in particularly in the episodic store this is how the schema really works.

So, as I was telling you that within the episodic memory of your graduation of what to do and what not to do there will be several schemas and these schemas are part of the semantic memory. So, whatever you do in your graduation party is basically an extension of the semantic memory. So, episodic memories have to have semantic knowledge or semantic facts embedded into it, but not the reverse case. So, semantic memories may not have things from the episodic store.

So, basically when you when I am talking to you when I am asking you what an apple is you need not remember the first time we were learned the what apple or the first time you have shown an apple and tool what an apple is, but then with semantic memory this is the independence that you have, but with episodic memory, this is not the independence that you have you when you describe an apple you have to know what an apple is or what defines an apple for example, a certain shape certain colour that kind of a thing has to be there, but you can also define or tell me the first time, you heard the word apple that is basically episodic knowledge.

(Refer Slide Time: 17:56)




So, let us look at the distinction of the episodic and semantic memory and so quick distinctions episodic memory as said it enables people to travel back in time and become consciously aware of witnessing or participating in events in earlier life. So, basically what episodic memory does is that it gives you this confidence it gives you that freedom to travel back in time. So, here I can travel in time and so, time travel has not been invented, but with memory studies we do travel back in time to that particular event it becomes live on to it.

So, episodic memory gives you this particular freedom to travel back in time and you can also witness that particular event. So, all although you cannot do anything to the event you can only remember it as a third person perspective. So, you can see an event unfolding front of you, you see yourself unfolding in front of you, but you cannot participate into it and that is the main problem with episodic memory. So, you can view, you can consciously feel the event, but not change it in an event that is why this time travel has a limitation. So, you can travel back, but cannot do anything cannot disturb anything into it and so that is what is episodic memory whether the semantic memory you have it contains general and world knowledge.

So, basically all knowledge is about where Africa, where America is, what is Germany? Where is Germany, who was Hitler, who was Napoleon? Who is the Pope? Who is the current Prime Minister of particular country? Who is Barack Obama and all kind of

information stories also is basically general world knowledge arithmetic rules like 2 plus 2; 4 plus 4, 2 into 2 and all those kinds of a higher arithmetic rules past tense of verb like what is the past tense of do what is the present tense of any verb..

So, run a makes ran running that kind of a thing. So, this kind of information which is their which basically is world knowledge or basically is knowledge is; what is semantic memory. So, quick distinction of these; so, episodic memory has to deal with personal experiences it is everything which is personal to you which you are involved into which yourself is the concern is what is episodic memory where a semantic memory deals with facts and concepts. So, it deals with those information which is world knowledge. So, you may be part of it you may not be part of it, but then this is a fact this is something which everybody shares and that is what type semantic memory is.

Now, when is say remember when it is basically episodic memory. So, I am talking about that time and that keeps to the third definition or the third quality of episodic memory where we will come to that in a minute. So, when I am saying remember when. So, remember when an incident happened I am actually asking it to access in episodic memory, but you ask you questions like remember what is a table what is a chair things like what is an apple what is water and all those kind of informations you remember, what is generally a concept of semantic memory now episodic memories are temporarily organised and so, it is time analysis or time based analysis.

So, you can see an event unfold in real time when you accessing when episodic memory which is just like the time line concept in your Facebook. So, you there are certain events put on to the time line concept and as you visit it you can see the event fold in real time that is what is the episodic memory, but then when you have semantic memory it is related or it is arranged in terms of meaning. So, meaning related arrangement is semantic memory and so, this is classic definition or distinction between the episodic and semantic memory.

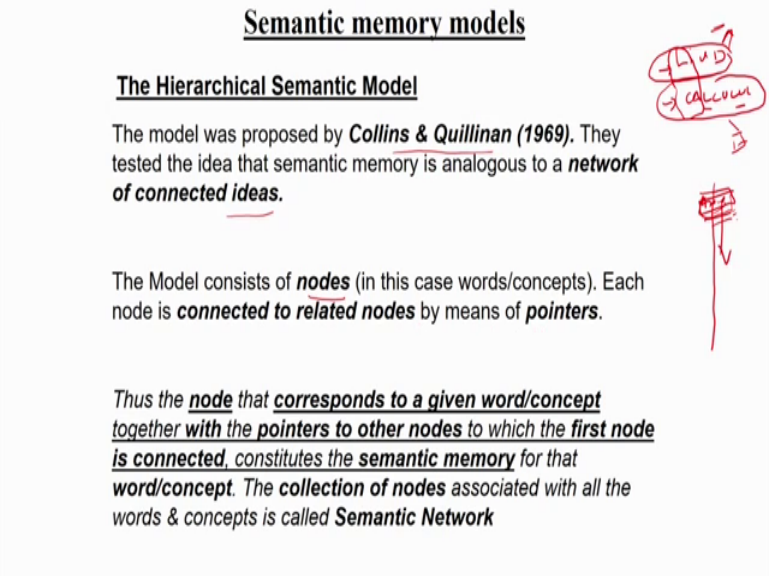
And so, there several evidences which were there to basically prove a these kind of memory systems are exist and one of the famous cases or one of the famous evidences was provided by Schechter in 1996 and so, he studied particular brain damaged person a brain damage patient called gene and when he studied this brain damage person what he

found out that a certain region of the brain specifically inhabitant episodic memory, but it did not inhabit the semantic memory..

So, this person was able to access semantic memory tell about facts about the world knowledge, but personally even this person could not remember back another evidence which is provided for this distinction of episodic semantic memory was by Talwin in 1989 where he looked at cerebral blood flow and he looked at cerebral blood flow when a person was accessing semantic memory and when he was accessing in a episodic memory and he found out this cerebral bold flow that was measured through APT scan they were different. So, basically different kind of blood flows exist in different regions of the brain and that is what the third thing is different brain regions are involved with the semantic and episodic memories. So, the blood flow was different all not only the flow the regions of the brain may also different for semantic and episodic memory.

So, now we come to know that the semantic memories are huge store it has a lot of information arranged on to it right the huge capacity. Now if a memory system has huge capacity because the world knowledge that you have is a huge to learn everything every someday everyday you learn something or the other huge amount of knowledge which is there. So, how are they organised what is the way in which this is organised and so, several debates were coming out there were several propositions of how they were organised. So, this is of that the full idea of, semantic models of semantic knowledge were proposed.

(Refer Slide Time: 24:13)




Now, one of the primary things that were happening is that researchers working in the field of artificial intelligence and computer science who were modelling memory back in the 80s, 80s and 90s, those people, they wanted to build a commonsense knowledge system a system which has commonsense which can explain commonsense things like how to do something how to open a lid of jar. So, how does a system like this operate if your commonsense exist from world knowledge only and so, they were thinking of designing a model now at this set is that with a lot of knowledge that we have the kind of knowledge that we have we have lot of implicit knowledge hidden within the kind of knowledge that we have which we are not aware of.

Now, take the example of a shampoo bottle now if you look at a shampoo bottle and if you look at the directions that it says it says wet hair take a little bit apply rinse wash and repeat. So, if a robot is given this to do if a computer is given to do this what it will do it will keep on doing this cycle of wetting the hair taking little bit shampoo putting it on rinsing it washing it and repeating it till the bottle is finished, but then with most of us that is not what we do we tend to stop after one or two rinses and we do not know wont continuing..

So, where does it knowledge the implicit knowledge of stopping after one or 2 rinses is where does it come from or how it is arranged and so, that particular store or that particular idea of arrangement was what was people looking at how is this idea or this

implicit knowledge where is it stored with the world knowledge because world knowledge is that you repeat. So, how many times you repeat that is the other question. So, a implicit knowledge in everyday routine inform you to know a lot of things and a lot of other things which you do not know that you know, but you take it for granted.

So, knowledge of language has an associate great deal of implicit knowledge also things like common things like certain other implicit knowledge for example, when I say the dragon had a liver. Now when I say dragon had liver you do not have to go to check the whole idea of what a dragon is or the whole structure of a dragon go to one museum and find out, whether it has or not you know that dragons are kind of mammals and most mammal tends to have liver and so, it can be generalised. So, this is implicit knowledge that if man you have or birds like dragon had liver. So, the dragon also had liver and so, this is implicit knowledge and so, people wanted to test; how is this implicit knowledge actually arranged.

So, one of the other reasons or making the inferences or making thinking about or modelling presenting models of implicit knowledge or semantic memory was how was the mental representations of various knowledge arranged. So, people also wanted to know when a fact or a knowledge is stored in a memory system what is the way in which these represented the representations are stored another interesting thing that was happening is that how are they accessed what is the speed of accessing. So, basically questions like this way asked that name words which has first letter l and name quickly words which has the fourth letter l.

For example, the first word could be livid and the and so, words with first letter l and the third letter is l calculus and so, are the seventh letter word l now if I ask you to name the number of words which are with first letter l and the word number of words which are third letter or fourth letter l, you will end up telling me more words which have first letter l and then the number of words which are the seventh or third or fourth or fifth letter l why because this shows this speed with which of how many words, you can retrieve can actually tell you how is the mental dictionary organised. So, basically mental dictionary then organised with the first letter remember the metaphor that we used in the book shelf. So, basically the first letter of Alice in wonderland that a l is, how it is arranged. So, a is Alice and so, you will find a lot of it and so, Alice in wonderland is arranged with a l the first 2 letters and this is how this thing really works.

So, basically then several models are proposed of the semantic memory and we look into a few models of a semantic memory which are here will look into couple of models will also look what how these models compare with each other and how one appreciates one model goes ahead and cancels or basically adds on to the limitation of the other model and how is semantic memory arranged. So, basically it was the hierarchical semantic model was the first model and so, this model does a number of things it tries to tell us how limited database is arranged for the huge knowledge.

So, how is the database for a huge knowledge that we have is arranged in or basically the number of knowledge that we have the number of facts and knowledge and things semantic things that we have how they are arranged also any model of semantic memory should be made in such a way that it should not store redundant things right things like let us say dog has 4 leg, right and cat has 4 leg and let us say any other animal has 4 leg. So, when I say that. So, each time when I present a dog has 4 leg cat has 4 leg animal has 4 leg.

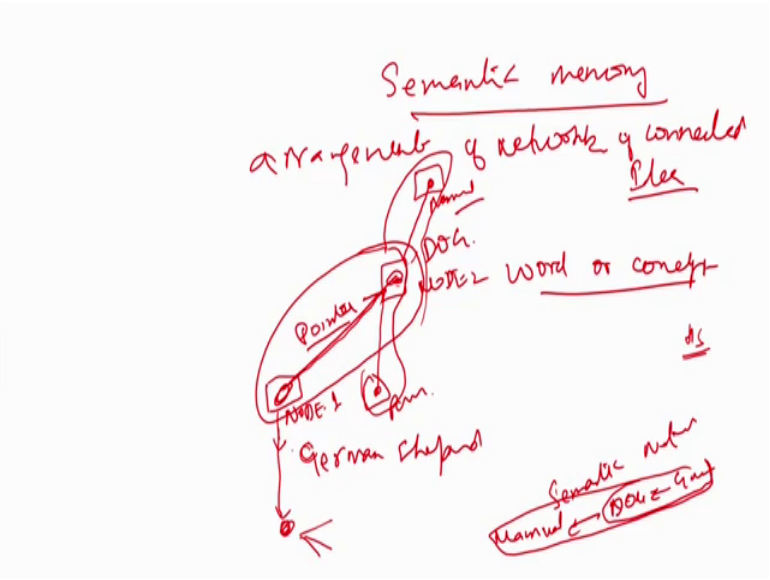
So, basically it should not be repeated this 4 leg the idea that this particular kind of a concept this particular kind of object has 4 leg should not be repeated with each instance which means that the idea that most mammals because anything which falls under mammals should have a 4 leg it should be unease in such a way that the higher category or the idea that any particular item within a category should have 4 leg and this 4 leg should be at the top of the feature at the top level.

So, if I am thinking of a hierarchical semantic model which means that knowledge is arranged in terms of hierarchy any knowledge in arranged in terms of hierarchy; so, top level hierarchy should have these facts because anything under that hierarchy should have 4 legs. So, lion tiger and all kind of a mammal I am talking about all follow under the animal category or the mammal category and so, that the model should be made in such a way that the mammal category should have in built the idea that it has 4 legs.

So, basically that kind of thing is there and what it does is it preserves something called cognitive economy which where the properties and facts are stored in the highest level possible. So, basically if a particular category, if a particular a structure is designed in such a way that properties and facts of the category anything which falls on the category and the main facts of those category should be at the highest level and then within that

you will have lower levels on to it and so, the first model of semantic memory was proposed by someone called Collins and Quillian and they tested the idea the semantic memories are locus to a network of connected ideas. So, what Collins and Quillian, they said is that basically semantic memory is something.

(Refer Slide Time: 32:20)




So, semantic memory is basically an arrangement of network of connected ideas. So, they define that any word or concept is arranged in terms of nodes and pointers towards also. So, these are 2 nodes this is one node node one and this is node two. So, then 2 concepts 2 words are related to each other through a node and the junction or the connection between 2 node is provided by a pointer.

So, people who are familiar with programming or c programming c plus plus programming they are familiar with this idea now this in terms of programming this is a memory location space which the computer provides you and the pointer points how to memory or location spaces are basically connected in terms of the hierarchical model by Collins and Quillian, what it says is that this is the memory area memory or location or this is the node for a particular word and this is the node for a particular word and so, if 2 words are there then they have different memory or location or different structures or different places located in semantic memory and they are connected by a pointer which points from the highest node to the lowest node.

So, basically then what they said is the model contains of consists of nodes in this case what the concepts and each node is connected to related nodes by means of a pointers then that is what I was also telling you. So, you this is the node let us say this is the node for any kind of dogs.

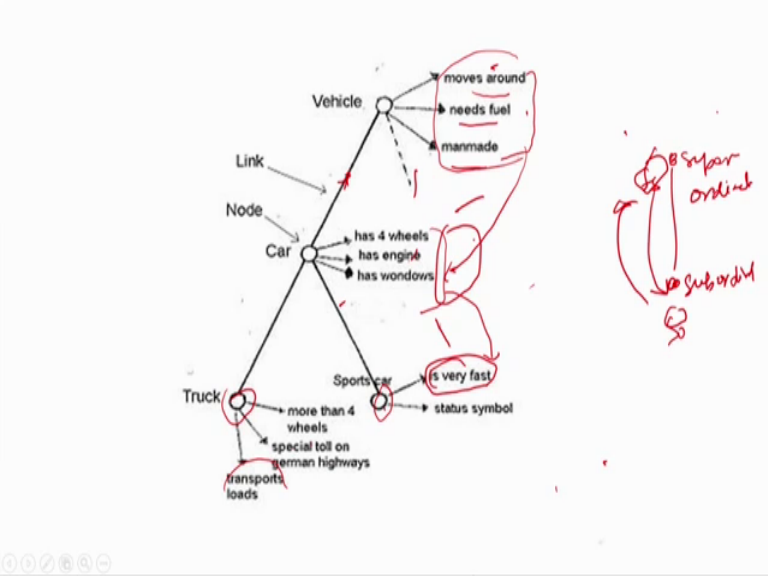
So, may be a German shepherd this is the node for a dog and so, what happens is these 2 nodes are connected because within dog you will have German shepherd and within the German shepherd also you can have another node which is different kind of German shepherds which would be there..

And so, what happens is within dog the German shepherd will fall and within German shepherd there will be others node also within the dog category there will be other node which are there; so, I will have a Pomeranian node also and so, on and so, forth. So, what is the fact here this is how information is stored and the dog will be again following under the mammal node the node for mammal and so, on and so, forth. So, will come to that in a in a minute. So, basically what is their idea is that this is how arrangement is nodes and then connection of nodes.

Now, thus a node that corresponds to given word or concept together with the pointers to other nodes to which the first node is connected constitutes the semantic memory. So, basically semantic memory is this kind of a structure and this kind of a structure that I am talking about of higher to a lower node kind of a thing is called the semantic memory network. So, semantic network is the network of mammal then following to dog and then following to a German shepherd this is a network, but dog and German shepherd within each other is what is a node?.

Node to node connection and the pointers are the pointing or what leads to what kind of a thing. So, that is what a this say and so, the collection of node associated with all the words and concepts are called the semantic network. So, let us look into this particular thing. So, quickly look into this as you can see here I will first rub this thing here quickly rub whatever is written here to show you what is there and so, this is the classic network that I was talking about and so, you as you can see here what you see here is very small network

(Refer Slide Time: 36:46)




And so, as you see this is the network of vehicle under which it a car falls under which truck falls and as you can see the vehicle has several properties which most vehicles which follow under the vehicle node would have and these properties are moves around it needs fuel its manmade. So, car is also vehicles. So, it has by default, it has moves around needs fuel and manmade these are the properties of the node remember the cognitive economy that we talked about and so, by putting these three features at the top node which is this is called the supra ordinate node and this is called the subordinate node.

Supra ordinate node is the node higher than a particular node of concern and and sub node is a node which follows under the super ordinate node. So, these properties then by default should be a property of any member of the vehicle and so, when I talk about and this is the link that is there and this is the node.

So, this is the pointer that I was talking about. So, vehicle will have these three features are the feature of any vehicle and so, these features should also be in car when I talk about car calls car also moves around car also needs fuel car also is manmade and when I talk about car it has 4 wheels has a engine and a window and so, within the car node, but then all vehicles may not have 4 wheels because 2 wheeler is also a vehicle..

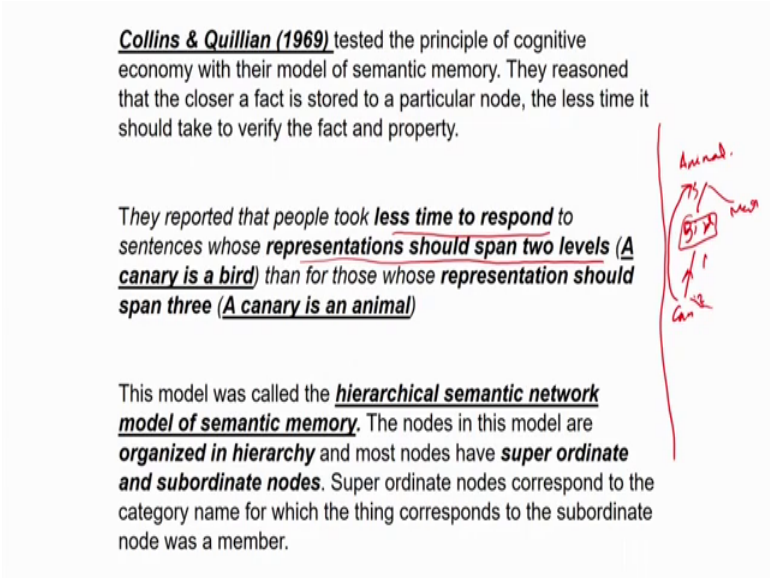
So, it may not have 4 wheels, but it moves around. So, these features are common. So, these features are common features to any item which is here, but features which are here

may not be here and so, 4 wheels engine and window and within the car they have 2 more nodes one is the truck node car follows the truck and then I have a variety of car which is the sports car it runs very fast status symbols. So, I will have a sports car and a sedan and so, on and so, forth which follow the car node also you will find out the; this is a sub node and this is a super ordinate node. So, any feature of the car will always be here. So, it always a sports car will have 4 wheels will also have windows and engines, but then every car will not run fast and so, this kind of a reverse pointer or this kind of a reverse matching is not true, but forward matching is always true.

Also truck is kind of a car which has 4 wheels, but it special toll and jam in highways and transport loads are something which does not this node does not have. So, they are separate with each other, but then they attract will always have 4 wheels, it will have a engine, it will have windows onto it, but 2 more features of it which may not be consistent with car and all of them will have this 4 features. So, basically, this is how it is the arrangement of the Quillian and Collins model of semantic memory he says there is a network of nodes and these network of nodes are connected by pointers and so, one network leads to the other also facts which are stored at the highest network which is the super ordinate node.

So, the highest node is called the super ordinate node super ordinate node and the one which is beside, it is called the sub ordinate node. So, sub ordinate node. So, features which are super ordinate node will always be shared by features of the sub ordinate of feature super ordinate is shared by features of the sub ordinate by the feature of the sub ordinate may or may not be shared by the super ordinate node. So, this how Collin and Quillians defined the idea of semantic memory.

(Refer Slide Time: 40:11)




So, they tested the principle of cognitive economy in the model and as I said one of the things that needs to be tested with most models of semantic memory is the idea of cognitive economy that properties which of the highest properties which of the highest place in model it should have the it should have the basic concepts or all properties of the concepts; so what? Then concepts should be always at the highest node or the super ordinate node.

So, they tested the principle of cognitive economy with this model and they reasoned that the closer a fact the stored to a particular node the less time it should take to verify a particular property. So, if a particular item or particular fact or a concept is stored very close to another node very close to another concept it should take less time to verify then if it is stored far away and they tested this particular thing. So, they reported that people took less time to respond to sentences whose representations should span 2 levels a canary is a bird then to representation which should span 3 level.

So, then let us look at this particular how this arrangement is. So, basically I have the arrangement of animal and within animal we have mammals and birds and within birds I have the canary the parrot and so, on and so, forth. So, when I am verifying and they said that since if cognitive economy is to preserved if words which are concepts word higher order concepts should be stored above a lower order concept if that is what the idea cognitive economy is because our properties of word has to be shared by canary property

of animal has to be shared by word if that is how the arrangement is, then people should take least time in verifying canaries or bird then verifying canary is an animal and that is what it actually happened with them. So, they took that people, they saw that people took less time to response to sentences representation should span 2 levels canaries or bird, then for presentation which for spanning three levels..

So, this is one and 2 level and this is 3 level. So, basically cognitive economy is preserved here also the model was called the hierarchical semantic network model of semantic memory. So, this particular thing because what I have is the higher order concepts or the concepts which have basic features which every items on that particular concept every item within that concept should have should be the highest level and within that well have other items and so, the properties of concepts will be shared by any item which is under that particular concept.

Now, the nodes in the model are organised in hierarchy as I said there is a top node then there is a another node and then there is another node and node node and all are pointed by all are connected by a pointers now a very good example of thinking of it is think of your windows when you think about your windows you have this tree structure and so, there are folders within folders within folders within folders if you have I have worked with the Linux system you will find out that there is a path that we talk about p a t h and this path is basically how nodes are connected.

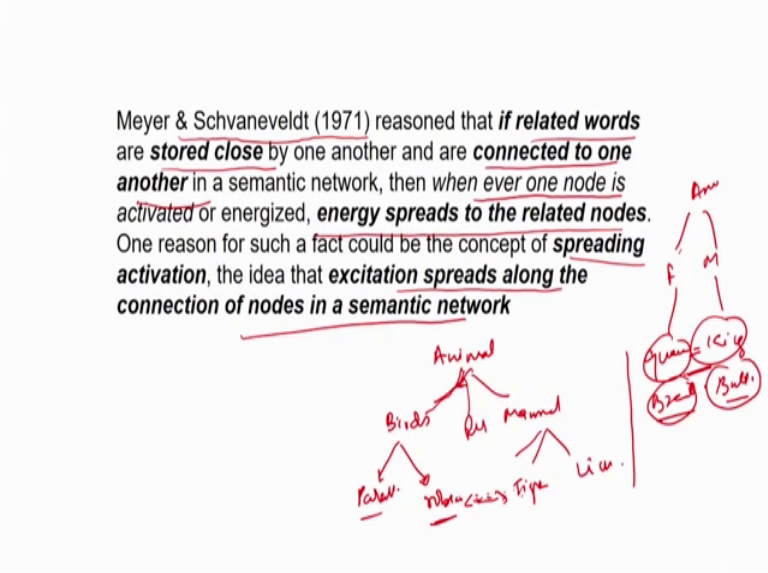
So, because if you have to. So, let us say there is in Linux you have the first part as slash route and then within that you have slash e t c and then you have something something and then within this you have generally have s t c and within s t c you have US r which is the user and then you have the home and then you have your desktop. So, if you want to reach your desktop you have to go through this path and this is how the semantic network is also connected.

So, route is the one which is the highest level concept with super ordinate concept within that the e t c is there which is the sub ordinate concept within that the s t c is there which is another store which is there within that user is there within that home is there and within that your area is n which is basically your desktop.

Similarly, they have a system like this. So, then most nodes have super ordinate nodes and sub ordinate nodes. So, node above a particular node is super ordinate just as we saw

in this particular thing; in this particular example. So, what we had is vehicle is a super ordinate node and truck is a sub ordinate node or sports car is a sub ordinate nodes. So, that is what is what it has been saying here.

(Refer Slide Time: 44:29)




Now, with a model like this where we have this kind of super ordinate sub ordinate node and things which are saved in this way good experiment was done by Meyer and Schvaneveldt in 71 and they reason beautifully they give this reason that if related words are stored close on one network and they are connected to one another in a semantic network then when one node is energised energy should actually spread to really related nodes one reason is that spreading activation the idea that exciting us particular network along a connection of network in the semantic network. So, let us try to understand what this is..

So, we have the animal node and within the animal node will have something called the birds and mammals and within the birds and mammals well have let us say a parrot and another one is let say a robin and within the mammal we have a tiger and we have a lion. So, what he says that when and so, birds is birds and mammals are not connected to each other, but then what he says is that when some energises one some energies once somebody is accessing their animal node this activation that follows to the bird should basically go ahead in and excite both parrot and robin at the same time or with. So, robin may not be connected to tiger in any way, but then if they are connected in some way if

these nodes because some kind of connection would be there between robin and tiger of course, is very difficult to explain what it is, but they might both be kind coming from animals and so, then kind of connection would be spread between them.

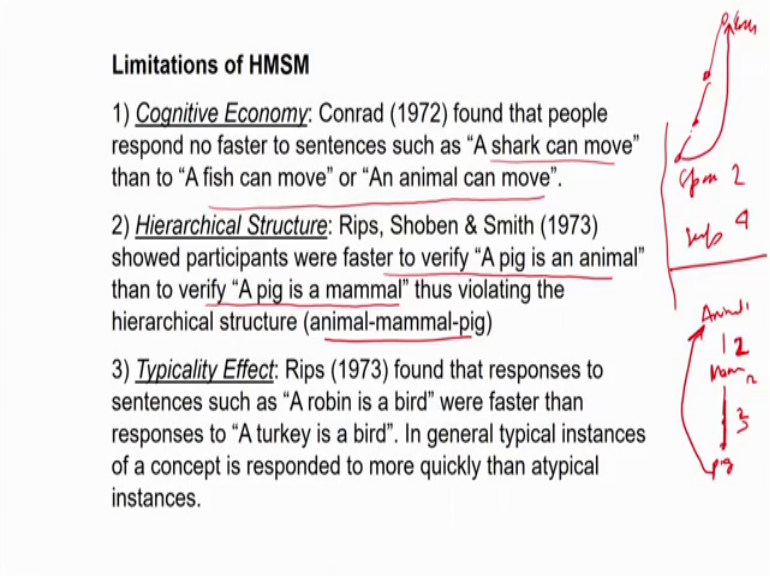
So, when I energize this animal or when somebody starts travelling from this animal down to birds both this node will be activated right and so, within the birds you will have colourful words non colourful words and within the colourful and non colourful you will have the talkative words non talkative words and so, on and so, forth. So, what they said is that when an excitation moves down or node like this what would happen is this excitation will not only spread to one node, but it will also spread 2 excitation spreads along connection of nodes in a semantic network..

So, this excitation would also go ahead and connect to tiger. So, tiger will be weekly excited, but then it will not be excited. Now, how robin is connected to tiger this very difficult to look at, but then there will be certain mammal which may be related to robin in some way or parrot in some way and so, that excitation will always be there or connected this and that is why they said this is because we have always found out that when I say queen people say king.

When I say bread people say butter now when you look into it bread and butter, they are 2 different things king and queen are 2 different concepts which altogether queen is from the female category king is on the male category, but queen and king are related to each other and there this relation is basically can only be explained through the idea of this spreading activation, what happens is when an activation when the node is energized this energy also spreads now it does not only go to the node which is sub set with it. So, we will have reptiles also for example.

So, when animal is excited reptile nodes also get excited on to it. So, king-queen queen although been this is female and male and so, on top of it if we look into the node of animal. So, within animals we have male and female within king and queen. So, although they are different, but some kind of activity relate them and so, this was an basics example to show that these nodes are connected to each other now.

(Refer Slide Time: 48:34)




There are several limitations to this particular the hierarchical model of semantic memory one is about cognitive economy as a Conrad in 72, 1972, they found that people are no faster to verify sentences like a shark can move then a fish can move or an animal can move. So, what they found out is that even if we span. So, if we span let us say 2 levels or if we span 4 levels on a network. So, let us say it is a 4 level network 4 nodes. So, when we verify a sentence which was 4 node far from the sub ordinate super ordinate node people take almost the same timing..

So, this idea of cognitive economy was not preserved by this hierarchical semantic network another problem was the structural the hierarchy itself. So, Rips and Shoben Smith, they showed that participants were faster to verify a pig is a mammal than to verify a pig is an animal. So, basically they quickly identified pig is an animal than pig is a mammal now if you look into it animal is the highest node and then within that you have mammal and within that you have several other things, let us say 2 more nodes are there and then you have the pig which is actually a mammal.

So, when people verify pig is an animal which is let say that is directly connected here. So, we have 1 node and 2 nodes. So, when people are verifying 1, 2 and 3 when were people are verifying 2 levels and people are verifying 3 levels people verify three levels faster than 2 levels and so, and this is what the thing would look like. So, they found out that this idea of hierarchical structure was violated by the hierarchical network model

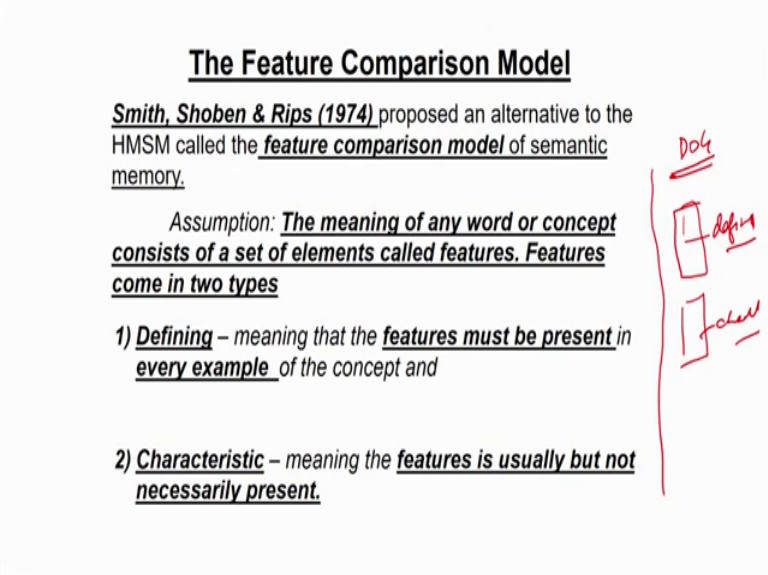
also typicality effect was another reason or another limitation of the hierarchical semantic model what it says is that birds which were typical for example, robin parrot birds of sparrow these were faster in verification.

So, when people verified a robin is a word or a parrot is a bird they are faster to say yes verifying the sentence, then to verify sentences like ostrich is a bird or a turkey is a bird or a hen is a bird now if you look into it both hen turkey and ostrich are all birds, but then people took more time to verify these sentences now although if you look into it ostriches and turkeys both have the same kind of structure the same kind of features as a robin or a parrot would have.

But when we are verifying this when people verify this kind of a structure and people verify this kind of a typical verses non typical instance of a particular concept people are more prone to verifying the more typical instance then not typical. So, the idea that all elements of a concept are not arranged are not verified in the same manner and so, this is typicality effect and so, rips found that problem with hierarchical semantic model.

So, since these were the problem that were there the violations which are there another model call the feature comparison model was actually proposed which would go ahead and solve some of the problems which the model of hierarchical semantic and network one actually doing.

(Refer Slide Time: 51:58)



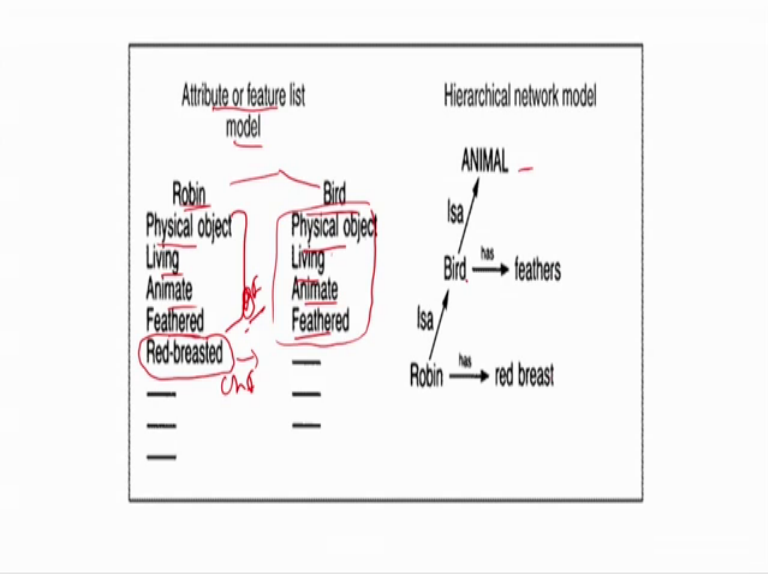
So, what was the model like? So, Smith Shoben and Rips, they proposed an alternative model to the hierarchical semantic model which has called the feature comparison model or semantic memory assumption was the meaning of any word or concept it consist of set of features or elements called features then features come in 2 types. So, he said what they said is that semantic memory is not arranged in terms of some kind of a structure or some kind of hierarchical structure, but they are arranged in a way in which there are certain features.

So, there are 2 basic features that we talk about. So, when I am looking at any concept let I am look for example, I am looking at dog. So, the dog has 2 kind of features one is called the defining features of a dog and then there is a characteristic features. So, facts like it has 4, it barks, it has 4 legs, it has a tail which wags are defining features of a dog because most dog will have them and then there are characteristic features which some dog may have and some dog may not have, for example, there is a dog they shout there will does not bark and then there is a dog which has very a less tail for example, you have a dog which has no tail at all and then you have a dog which has a huge tail or there is a dog which have or think of a dog which has three legs on this.

So, how do you accommodate for that. So, that kind of a thing is there and so, most dogs whatever they have is defining feature and some dogs may have features which are extra which are called characteristic features and so, this is what it is. So, the meaning of a word or concept consist of set of elements called features and features generally come of two types defining features must be present in every example.

So, every dog should have them 4 legs barking or tail or greedy or men's best friend is what most dog should have and so, these are the finding features and characteristic features are those features which are usually not necessarily which are usually, but not necessarily present for example, barking as I said or other features for example, big tail or facts like drooping ears, long teeths, these kind of features may be there may not be there or glossy skin may not be there or the height for example, Scent Bernard are dogs which are very high and Chiwawa dog which is looks like a cat and so, they may not have the same feature.

(Refer Slide Time: 54:17)




So, for them this is the kind of network they thought about this is the kind of feature related fact that they talk about and so, if you look at attribute or feature of a model for example, I am from looking at a robin and from looking at a bird. So, they are 2 level concepts bird will follow or birds are the super ordinate node and the robin is the sub ordinate node..

So, if you look into it both are physical object both are living both are animate both are feathered. So, these are the features which are the features which are defining. So, any bird will have any bird has physical organism as living is animate and is feathered, but then this particular thing is called the characteristic feature of a robin because most bird may not be red feathered and or red breasted and so, this is the characteristic feature and all these are the defining features because defining features is something which most of the elements of this concept should have whereas, if you look into the comparison with hierarchical model hierarchical model says animal is a bird which has feather is a robin which has red breasted and so, this kind of thing this network has a problem because they should share.

So, words has feathers or robin should have feathers, but red breasted that is the kind of problem which is there and so, this model has this problem which is solved by my feature model or the new of feature model of semantic memory.

(Refer Slide Time: 55:50)

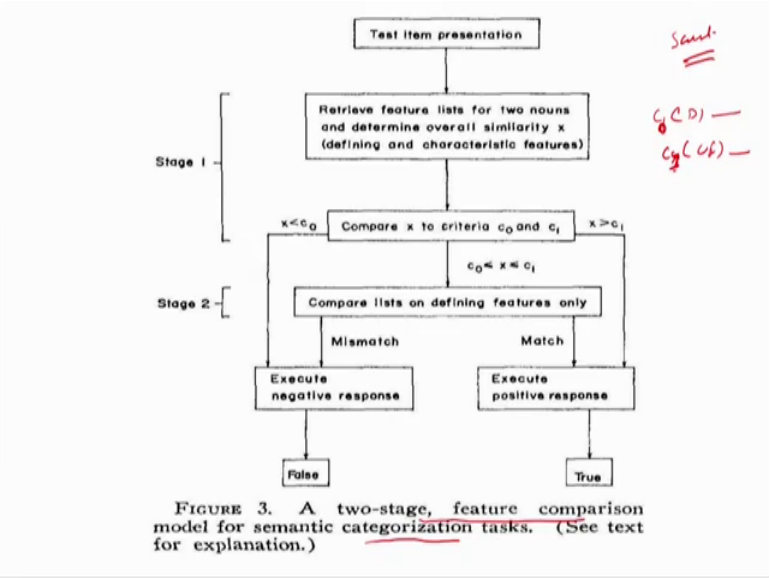



FIGURE 3. A two-stage, feature comparison model for semantic categorization tasks. (See text for explanation.)

So, what it says is that when why does the verifying sentence problem really occurs or how do sentence verification happens according to the feature network model or the feature model according to the feature model the first step is the presentation of an item. So, when I show you a new item attach presentation is there and we retry features as a list of 2 nodes and so, basically c 1 is the defining feature here and c 0 is the characteristic feature of a particular thing. So, I present a Scent Bernard to you and I ask you to verify this whether this is a mammal or not whether Scent Bernard is a mammal or not and so, when you look into it and stage one you look into characteristic feature and the defining feature of Scent Bernard.

So, what happens is initially the first step is to look at the all the features or gather all the features then compare x to the criteria c naught and c 1 if x is less than c naught which is the characteristic feature which is that I am sorry the defining feature if it does not has the defining feature for example, it works and so, Scent Bernard does not bark let say then I can move this way.

So, c naught is the defining features c 1 is the characteristic feature and so, if c naught x is less than c naught or c naught is greater than x then I move here execute an negative response and say it is false. So, if I if I have a cow a calf and I am trying to say to you that this is a Scent Bernard and the calf goes mow, mow and does not say a bow bow

which is what a dog should say and this is the defining feature of barking and so, I can execute a negative response in this is false.

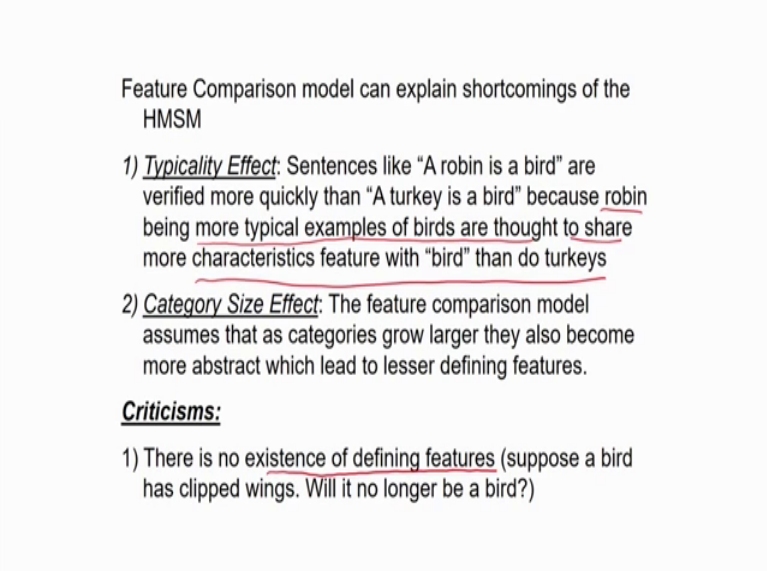
Otherwise there could be other things that if I can also compare the characteristic feature or if the match is not of even of a characteristic feature I can or even if some characteristic feature matches. So, may they may not be defining, but a characteristic feature for example, I said there is a dog which does not bark, but it looks like a dog which has a glossy skin it has a tail which wags and it looks more less like a dog droopy hairs all those characteristic features are there and so, if it matches even the if the characteristic features matches and execute positive response it is true, but in cases where my response the response that I get by comparing the characteristic and defining feature is in between the characteristic and defining features..

So, the amount of if the amount of defining feature is very high I say yes I am I new item is a part of this particular list, but then if it is very low I say it is not part of a less. So, if it does not has the defining feature I say false if it has very high amount of defining feature or some very high characteristic feature I say it is yes, but if it is in a medi-cure range if it is hiding having neither very high characteristic feature nor very less than defining feature I go ahead and do that I compare the defining features then. So, defining feature does not come into play in comparison in the in the feature model until then unless it falls the comparison of features falls in the medi-cure range when the characteristic feature is looked at.

So, first step is I gather all the features then I look at the characteristic feature of a particular item which has been presented in the characterized feature is very less is matching the characteristic feature then the new item has matching to the concept is very low I will say no it is not part of this particular category if it is very high I say it is a part of it in a circumstances in the characteristic feature is somewhat medicure, it lies between the defining and the characteristic features or not too much of characteristic features represent, but it has some characteristic features, I go ahead and compare the defining features only the defining features only if there is a match with the defining feature, I execute a true response or I execute a false response and this is the 2 stage characteristic feature comparison for semantic categories.

So, again very quickly what I do is if a new instance comes in first I compare the characteristic feature high comparison of characteristic feature or high number of characteristic features present I say this instance belong or this incident or this item belongs to my category low amount of characteristic feature present I say it does not belong if the amount of characteristic which have present is somewhat in between low and high I go ahead and look at the defining features if the defining features is high, I say a match is there defining features is low I say execute an negative response and it is false.

(Refer Slide Time: 60:27)




So, feature comparison model why it is good because it can explain some of the or sort comings of the earlier model first typicality effect sentences like a robin a bird, I verified more quickly than a turkey is a bird because robin becomes more typical example of birds then thought to share more characteristic features of the bird. So, robin shares although it has a number of defining feature, but when you actually look at robin it has a lot of characteristic features add on features with the bird and so, they are verified much quicker, but when I look at a turkey when I look at an ostrich they do not have a number of characteristic feature.

So, a stage to verification has to be looked at, but what happens is the comparison with robin is only in stage one it has a lot of characteristic features which is of the word and so, it is categorised and it is easy to verify robin is a bird also category size effect what is

says is the category goes higher. So, if there is sub ordinate super ordinate category and within that there is sub ordinate category if the category is small when the characteristic feature list of characteristic features will be small and so, verification will take less time, but if a category is huge, if I am talking about mammals, then they will be all kind of mammals which is there and so, if I am talking about a system like that what will happen is the verification time will be more and so, as categories grow as the number of categories grow as the kind of verification category is a huge it will take more and more time this is called the category size effect.

Now, what is the criticism to that the criticism to this theory is that there is no existence of defining features what is a defining feature nobody knows and so, there is no there is no existence for what a defining feature should be suppose a bird has a clipped wings will it be called a words. So, what could be called a defining feature is not very forth coming here or not very present here.

So, in this lecture, we looked what is semantic memory, we looked at how they are running, we looked at the episodic semantic distinction and we also looked at a the 2 basic models the hierarchical semantic model and the feature comparison model and how these model compared to each other and they go ahead and sort of complement each other in the next lecture well look at some other models of semantic memory and also something of how semantic memory really works.

Thank you.