Lecture 17
Word Meaning & Lexical Access

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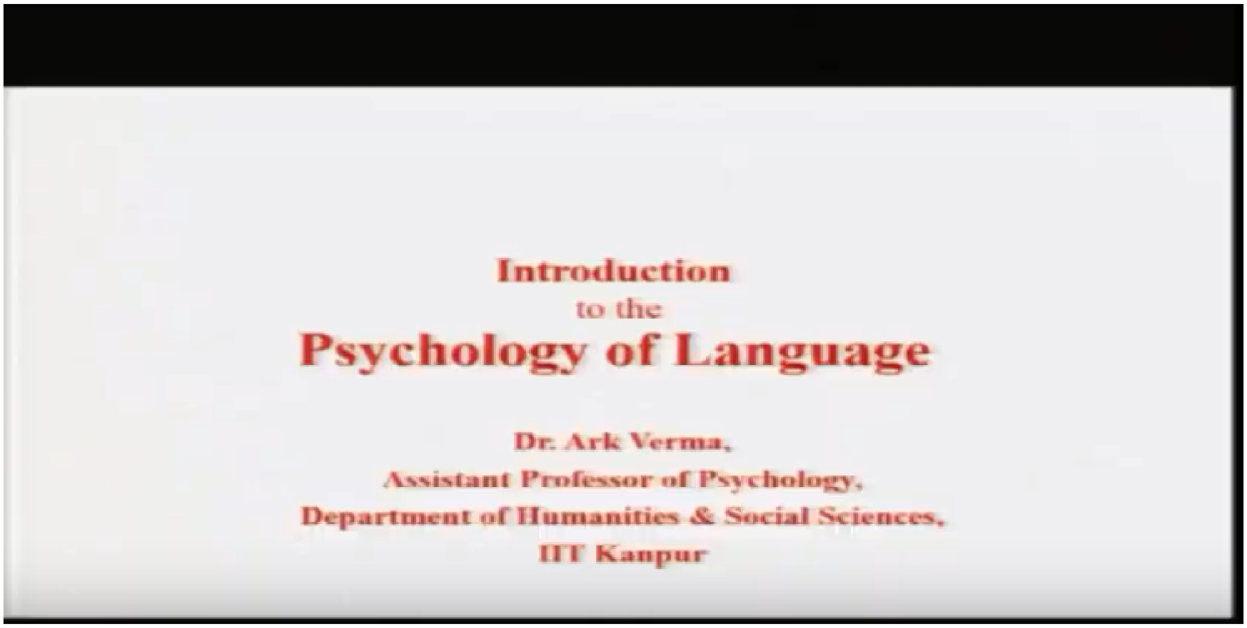

Hello and welcome to the course "Introduction to the Psychology of language" I am Ark Verma from IIT Kanpur and we are in the fourth week of the course.

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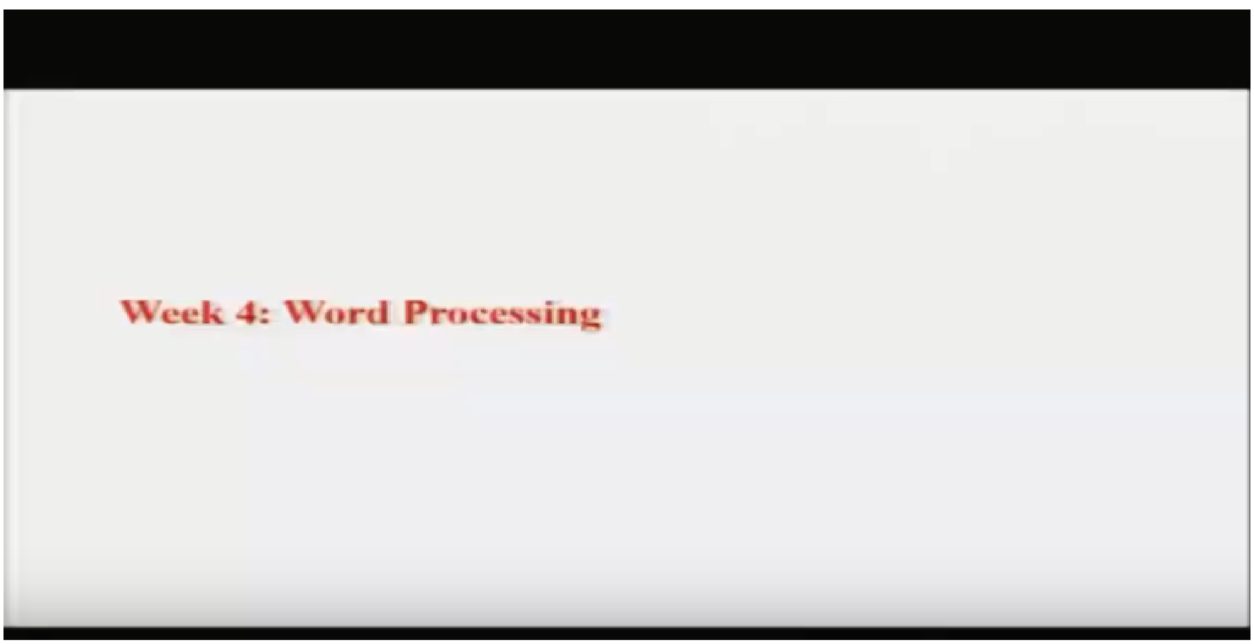

We are in this week talking about word processing, word meaning, how do you use words, how do you store the meanings, how does meaning get represented in the brain and so on else.

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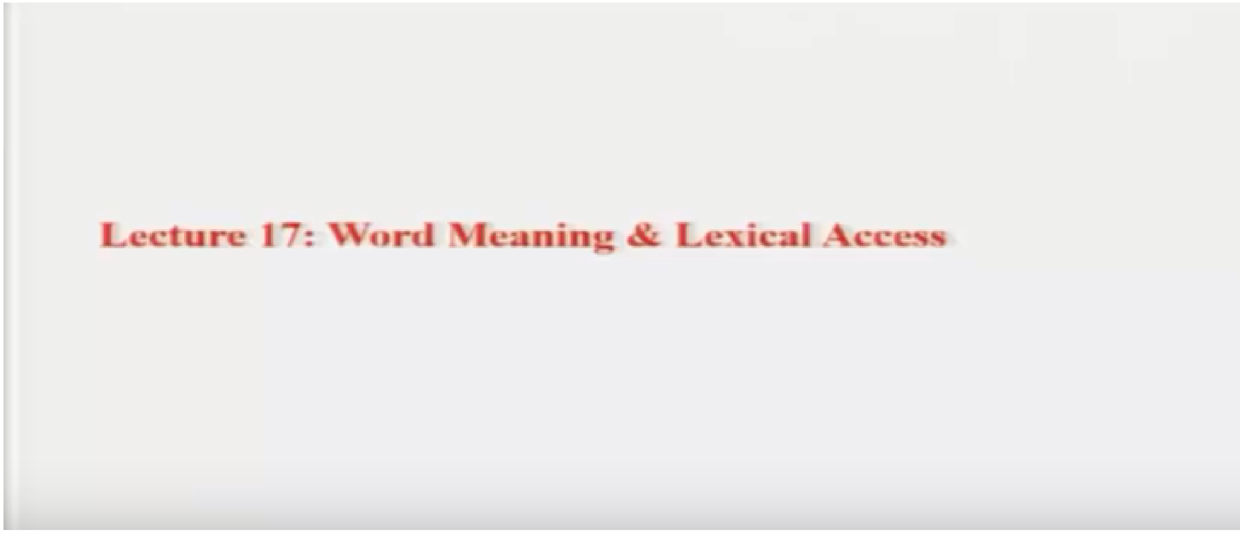

So forth this is only the second lecture of the week. In the last lecture, I talked to you a little bit about how meaning might be represented. We talked to you about one of the ways that could be introspection, we talked to you about a sim, the semantic networks theory which was propounded by Collins in Finland, we also talked to you a little bit about Association, Okay. How words could be linked with each other by just the virtue of being associated with each other. And that association could happen due to a variety of things, the Association could happen because they are semantically related but, the Association could also happen that, because those words are just co occurring together adequate number of times for your brain to be linking them up, Okay? So, this whole concept of fountain and pen being associated. Even though fountain and pen don't have really in semantic relationship. If you really think of it but, they are just because mentioned together so many times that now in your head. Whenever you say fountain, one of the completions you might think of is pen, you know you might say for example, if you've read a lot of iron ruined, you might say fountain head is little bit that's a different thing, Okay? Let's talk a little bit about a different approach to understanding meaning and this, one of the, the crux of this approach comes in this question or in the concern. And the concern is, even if you talk about Semantic networks or you talk about Association, it is very interesting that say for example, we are linking the meaning of a particular word to another word, meaning of this one is meaning is related to the meaning of this one which relate to the meaning of the other one and to the other one and so on. And basically, what is happening is the entire concept of meaning is just staying within a particular level of this particular network, Okay? This basically has been you know people have identified that this could be a little bit problematic and problematic in a way, I will tell you how. There is this problem called the, ‘Grounding Problem’ and the grounding problem basically refers to the fact,

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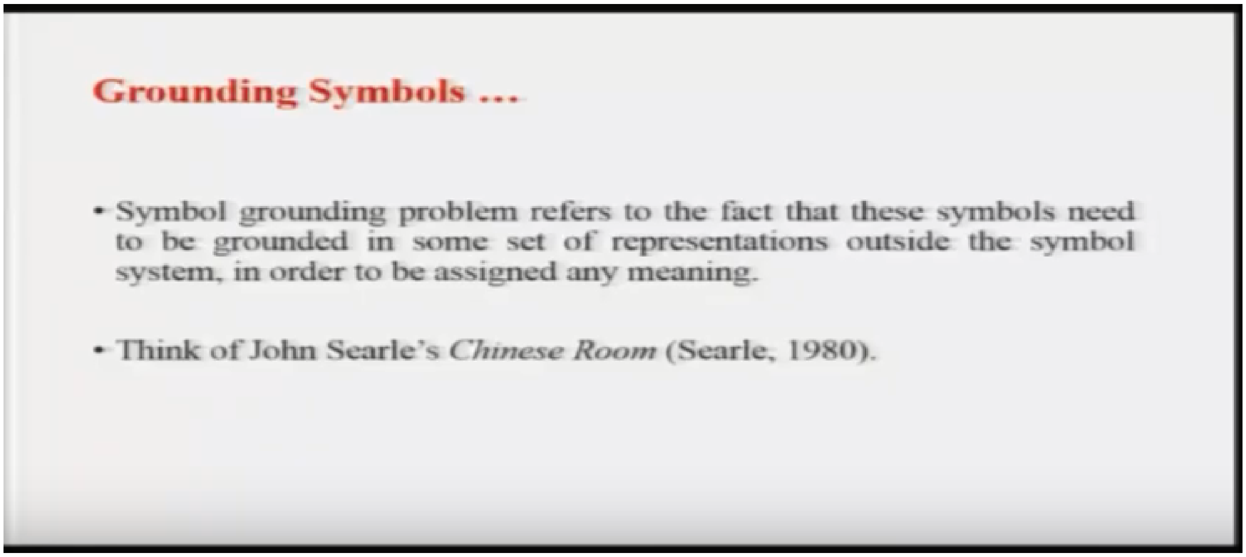

the symbols needs to be, you know, grounded or symbols meanings need to be, grounded in subsets of representations outside the symbol system, Okay? I can take an example to elaborate this to you as well. So, if you elaborate any anything from John Searle, you would probably have read a little bit about Searle's Chinese Room Problem and the Chinese room problem goes like this, it says that imagine yourself that, you are in this room and the room has no doors, no windows, nothing, but it just has couple of slots and in this couple of slots basically what can happen is that, somebody who's there, who's outside this room and somebody can kind of you know from one of these slots send in a card and this person has written in Chinese on that card, Okay? Somebody writes something on Chi in Chinese on that card and puts it through the slot, you look at that symbol and there is a directory here that, whenever this symbol comes, this another symbol has to be given. So, you are waiting somebody sends in a symbol, you see a chart this symbol is coming this symbol goes with this one. So, I send out that symbol. Another symbol comes, I know another symbol that I have to give other symbol comes I know, another symbol that has to give. Now, if this is happening perfectly fine and in some sense, you are answering all the questions that are being posed by this person outside in Chinese. So, the entire conversation is happening in Chinese the cards outside and the cards inside are both in Chinese, how do you really you know say, what do you really say about the knowledge of Chinese that this person has or you have at this point? Very easily it can be said that, you answered all the questions that came inside in Chinese by using some of the symbols that were in Chinese. But, you did not know any of these Chinese; you did not know any of the what the symbols mean? So, the idea is by association or by semantic networks what probably can happen is that, your entire conception of meaning is just stored in one network in one place. In order for you to actually understand the meaning of something the meaning should be stored outside of the system in a separate manner you know. So, Meaning say for example, if you ask me what is an apple? And I tell you an apple is a fruit which is red in color and sweet in taste that is one way of describing it. But, you know you might not get satisfied with that, Aray! What is in Apple explain me I can draw that to you but that says again a representation. What is an Apple? If unless I eats that Apple and touch that Apple and interact with that Apple, I don't actually know what an apple is, you know people know, people talk about so many different things so many different you know, Yeah! Concepts some things that you've never really come across or never really personally experience. So, part of the whole meaning understanding exercise should be some kind of experiences that you can have, and these experiences can be first hand or this could be associated in a vicarious way as well. I'm not saying that everything you'll have to have firsthand experience with you know you might remember this very interesting movie called, 'Ankhon Dekhi', where in you know something of similar sort is discussed, but the idea is coming back to this, is that the symbol grain grounding problems raises the very important concern, meaning should be stored outside of the symbol of a system of symbols, you know for a comb was referred to as the follicle distribution system, Okay? But it does not tell me anything if I don't understand what each of these words mean. So, if I just go by dictionary entries I'm describing the words in another words and that is what I am doing, I am not really getting to the meaning, it should be more than that, that more is basically you know a handled in a different kind of approach to meaning, one that is referred to as Embodied semantics and that is what we will talk about now. So, Embodied semantics, Embodied semantics basically believes that

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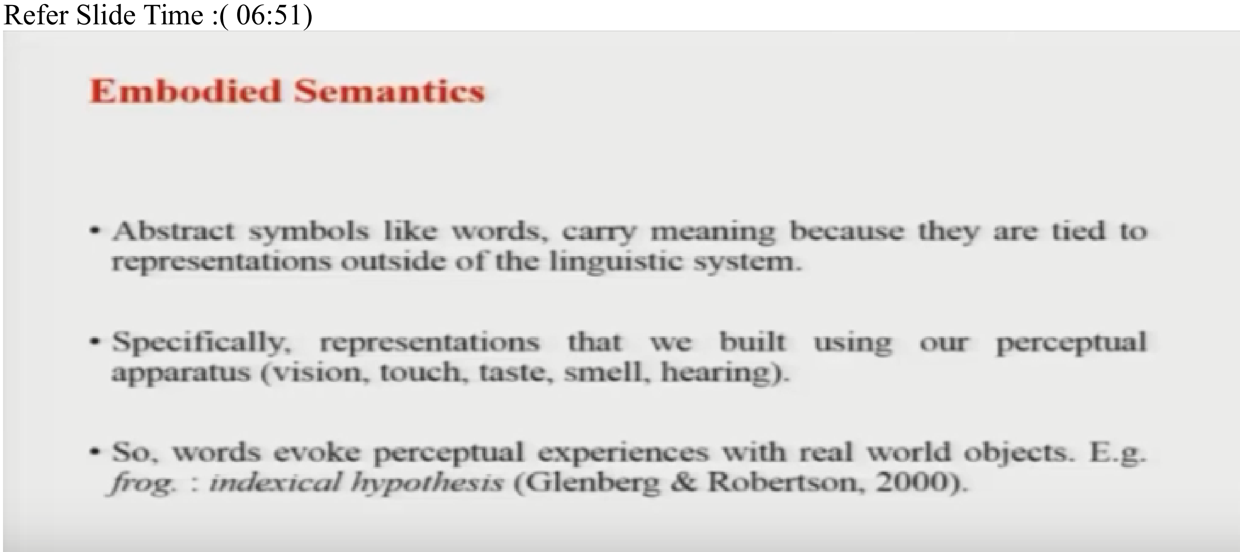

Abstract symbols like words they carry meaning because, they are tied to representations outside the linguistic system. So, these words and their representations are basically are tied to other kinds of representations which are not linguistic in nature but, which might be sensory perceptual in nature, which might be perception action. You know perception and action kind in nature. Say for example, the representations you could be willed up by our sensory apparatus or perceptual operator. So, touch, taste, smell, those kinds of things. So, words basically what they do is, they have meaning because they evoke these perceptual experiences with respect to these, real world objects. So, when you say Apple, I can imagine that red fruit, I can imagine its taste and that is how I'm understanding what exactly the word Apple means, Okay? That is, that is this thing, and this happens using something called the Indexical Hypothesis, will talk about the indexical hypothesis now. The Indexical Hypothesis was put forward by Glenn Berg and Robertson in the year 2000. What is the, what is the indexical hypothesis says? Indexical hypothesis prescribes

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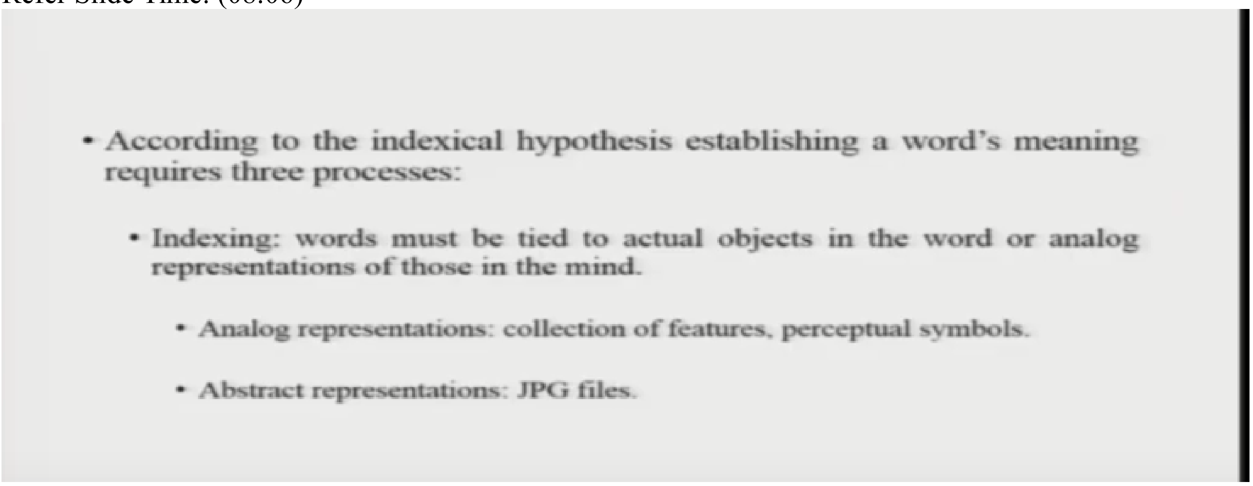

a particular way of establishing avoidance meaning and it says that, basically this entire process should have three this entire you know system should have three basic processes. The first process will be indexing. So, indexing is basically that the word must actually be tied to actual objects in the world or analog representations of those in the mind. Say for example, cat, bat, rat, dog etc., should have actual representation in the word that you know, this is the object that is what stands for something like that or It could be abstract representation, I could be talking about this particular image. So, Triangle or you know anything for that matter. The another important process in this indexical hypothesis after is. So, one was indexing the other is Affordances. What is Affordance?

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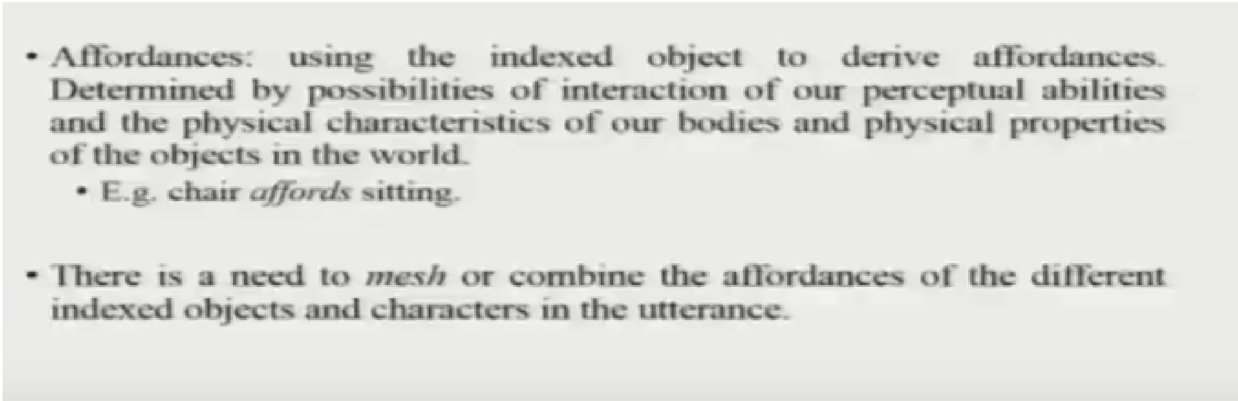

Affordance is basically using this indexed object to derive some kind of action possibilities you know, Affordances are action possibilities. What can you or how can you interact with this object, Okay? And this basically is the set of possibilities of interaction and this is partly derived by our perceptual abilities and partly by the physical characteristics of these objects. Say for example, a chair affords sitting ,when I look at a chair, I know that I can sit on that chair you know, partly it is because I am seeing the chair and I'm kind of judging from the physical characteristics of this, second is I know what sitting is both, both things, Okay? The combination of this is called, you know judging Affordances. So, first was indexing, second was Affordances the third important concept here is this concept of Meshing. What is Meshing? Meshing is when you look at this word, you look at its index and you look at its Affordances and you combine the index objects Affordances. So, Indexing and Affordances you just combine them together. So, you mesh or combined Affordances of different indexed objects and characters in that. So, that is that defines the whole utterance, that is what basically conveys the meaning of that entire phrase or structure or a word that you're going to say. So, what are you doing I'm kind of let us you know, say this again in a very simple manner, if you come across a word or a phrase or a utterance, first thing that you will do is, you will look for its indexing, What does it represent in the actual word and, the second is, how do you interact with that object? So, Affordances, and every object that you would know of chair, it is represented by this set of sounds and affords these kinds of interactions. So, both of them together get initiated, whenever you hear a word or suppose you have to understand the meaning of this word chair both of them should come together and be combined with each other or meshed with each other. This is the Embed Embodied semantics approach to meaning. Now, Embodied semantics approach to meaning that there could be you know you would want to test whether it is actually correct or not. So, we saw some tests with respect to the priming studies in the semantic networks and the Association Task. How do check for the embody semantics approach. Yes, People have devised some very, very interesting experiments; I discussed some of those experiments here.

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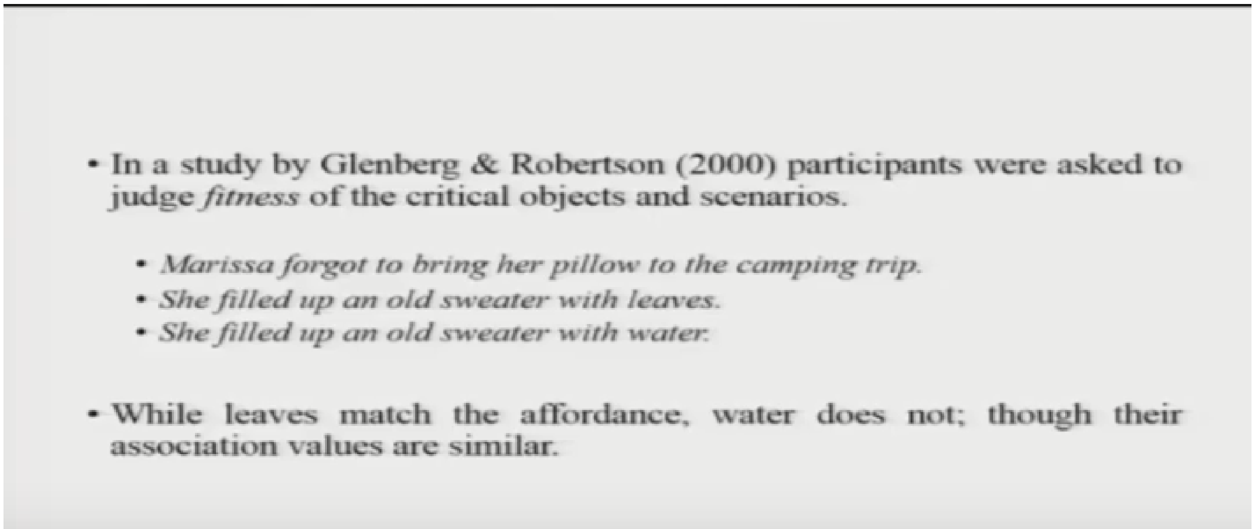

In one of the studies Glenn Bergen Robertson basically in the year 2000, they basically asked participants to judge the fitness of the critical objects and scenarios, however these objects and scenarios links to each other. Basically, they gave their participants these kinds of sentences, the first sentence was, Marissa forgot to bring her pillow to the camping trip and the second was you have to judge the fitment of the fitness of the second and third sentence to the first sentence. She filled up a known old sweater with leaves or she filled up an old sweater with water. So, you have to kind of read this and say which of the two sentences here fits better with the first sentence. What was the first sentence again, Marissa forgot to bring her pillow in the camping trip, All Right! She needs a pillow probably, she filled up an old sweater with leaves to make a pillow or she filled up an old sweater with water to make up a pillow. Now, what you have to do is, you have to read this B and C and it will say whether B fits A better or C fits A better. And Yeah! You can pause, you can check what do you, what is your suggestion, because leaves can be filled up as in the sweater and they will not really go you know either makes the sweater wet or not be feasible. Basically, because leaves match the Affordance of being filled up in the sweater, the second sentence is responded to faster and in affirmative, the second sentence you know the one that has water is not, Okay? Even though they mentioned that the Association values of both water and leaf is very similar but, Leaves work much better here as compared to water it was you know how leaves are in the real world, what kind of indexing they have, what kind of Affordance that they allow, Okay? So, this is one of the evidences, one of the studies that kind of tells us that yes, we do calculate Affordances of these objects that is the idea. Glenn Bergen shocked another study 2000, they asked participants to make

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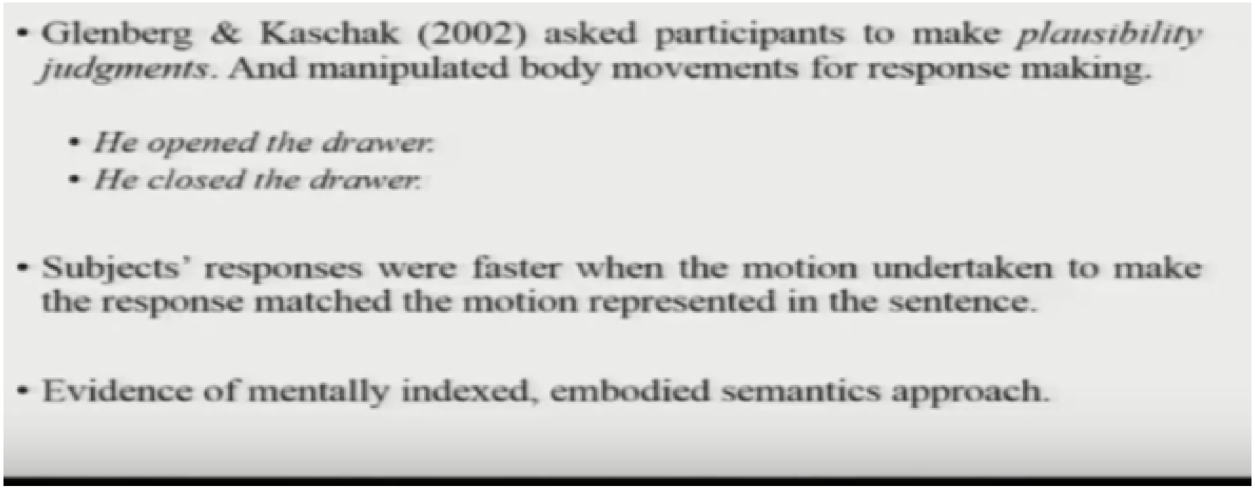

plausibility judgments and the plausibility judgments were like say for example, they had to say whether the sentence is plausible or not? While giving the response they also were asked to make particular kinds of body movements. What kind of body movements, what kind of sentences? Let us look. The sentences could be anything like, he opened the drawer and the other sentence could be he closed the drawer, you have to just see, is it plausible, is it not, can the drawer be opened, can the door be closed? Something likes that. While you were saying this, you're making the plausibility judgment; you would be required to do one of the two kinds of movements. The two kinds of movements were you have to say, he opened the drawer like this, or you have to say, he opened the drawer like that. Similarly, either you have to say, He closed the drawer like this, or you have to say, he closed the drawer like that. Now, you see here, if you know anything about opening a drawer the motion is this kind of motion. if you are saying this, he opened the drawer with making this kind of movement there is a bit of a match here, a congruence here. If you're saying, he opened the drawer by making this kind of motion, he opened the drawer there is a mismatch here in the actual action versus what you were doing so there is a bit of incongruence here. The idea is to check, whether the motion that you're making its congruence matters or not, what did they find? They found that subject's responses were faster when the motion undertaken to make the response match with the motion represented in the sentence. So, when there was congruence, subjects were faster. When there was you know incongruence, the subjects were slower, that is what exactly happened. Now, this is, this is this whole thing. If this kind of leads to the evidence you know, it kind of leads to the evidence in support of the mentally indexed embodied semantics kind of approach, Okay? So, this is how you know they say that, Okay. Maybe what we are doing is when we are reading the sentence; we are mentally stimulating this action opening of the drawer. Then because our mental simulation matches with this response this becomes slightly faster, when our mental simulation of opening the drawer does not match with this then our respond becomes slower. That is exactly what is happening here, Okay. And this is also taken as an evidence for the embody semantics kind of approach.

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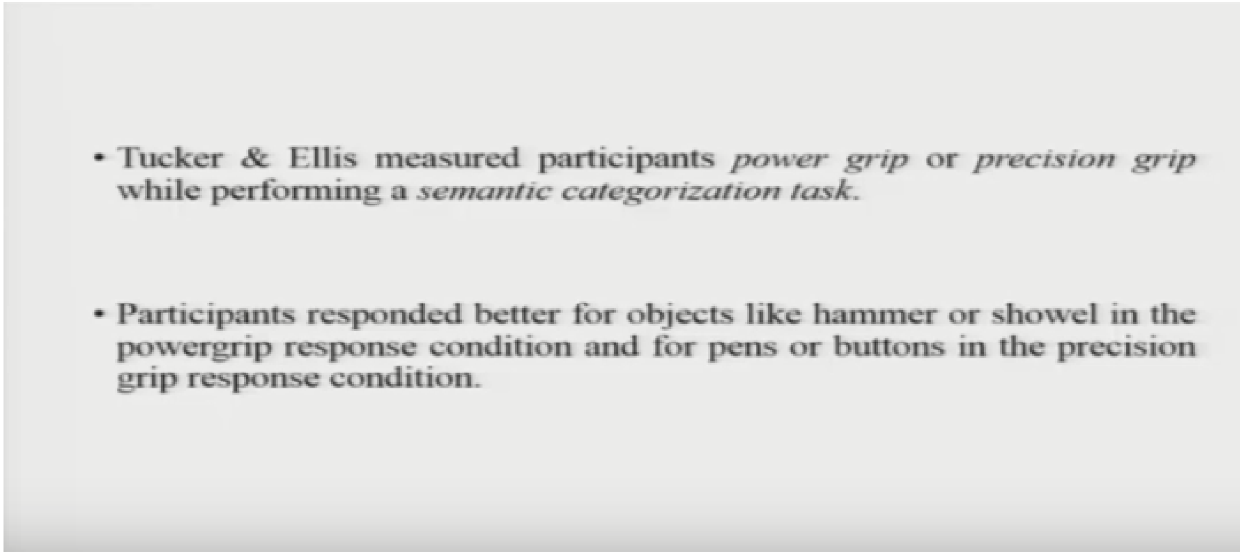

Another study a Tucker analyst measured participants' power grip or precision grip while performing a semantic categorization task. So, the participants had to do a semantic categorization task basically saying, whether this particular object belongs to this category or not. So, Animal or not, Tool or not, something like that, Okay? And, basically what they were supposed to do they were either used to you know basically make the responses by having a power grip. Say for example, the power grip is something that you apply when you're holding a weapon in hand. Say for example, a hammer or a showed. Is it? Is not a hammer or you know something like that, a precision grip is what you use when you have to write say for example, this is the precision grip what says this one is called the power grip, Okay? So, this is the idea, participants responded faster for objects like hammer or showel in the power grip condition. It was the object and the kind of grip that is there is congruent; participants were slower when you know they were to respond to these objects in the precision grip kind of condition. So, Hammer or showel in the power grip was faster, Hammer or showel in the precision grip was slower. Objects like pen were faster in the precision grip, obviously similar objects would be slower in the power grid condition. Again, the evidence of the fact that you know, we might be simulating some of these actions in our head while we're making these judgments. So, another kind of study,

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- When people respond to hand related actions like swing, the MEP activity over hand muscles decreases while that for feet remains unaffected.
- When arm areas of the brain are stimulated using TMS, lexical decisions to arm related words like throw were made more quickly.
- When *fMRI* was used to determine brain response to words that referred to movements of the face (smile), arm (throw) or leg (walk); neural responses were found comparable to the scenario when these movements were actually made.

When people respond to you know hand related actions like swing, cut etc., MEP activities of muscle, this motor evoked potential activity or hand muscles decreases while that for feet remains you know unaffected. So, if you are talking about verbs which are hand related action verbs the MEP activity decreases in their hand muscles because of some kind of preparation probably happening. But, it does not you know remain exactly the same for leg related actions. So, apparently the you know this processing is really happening in a very new really grounded sort of a way. When are arm areas of the brain are stimulated using TMS, TMS is transcranial magnetic stimulation, it is basically used to sometimes temporarily activate artificially activate or numb the brain by applying sort of a magnetic field, So, when arm areas of the brain are arm areas, the areas that support that control the movement of the arm these things in the brain are stimulated using TMS. Lexical decision to arm related words becomes faster, Okay? also in another set of studies, when fMRI was used to determine the brain response towards that, therefore two movements of the face like smile or the arm like throw or the leg like walk or run, Neural responses were found comparable to the scenario when the movements were actually made. So, if I'm asking you to make lexical decisions to face related words versus arm related words or leg related words, similar areas of the brain are activated, if as if you were actually doing that, Okay, that is something. How could this be happening, if you remember we talked a little bit about the mirror neuron Network in the speech processing week?

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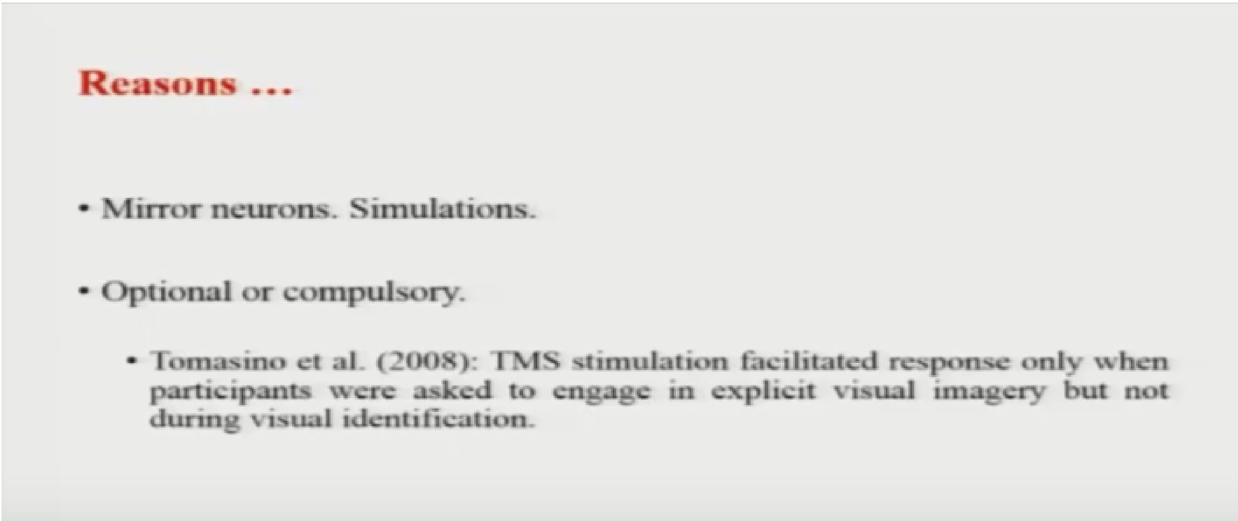

Last week that is. So, it probably is taking help of the mirror neuron system and these mirror neurons systems are helping us simulate these kinds of activities. There is a little bit of a question here is that say for example, whether this mirror neuron simulation is happens all the time and is completely compulsory or it could be optional or say for example happens in some tasks and does not happen in other tasks. One of the studies at least kind of says that, it might not be completely compulsory, or it might not be happening all the time. So, Tomas no in colleagues in 2008, they you know did this stimulation and they found what that the stimulation facilitated responses only, when the participants were actually asked to engage in explicit visual imagery but not really during just visual identification. So, these are there's this competing set of evidences that are coming in, Okay. So, let us talk a little bit about so this was a little bit about meaning. So, if this is the end of the meaning part, what did we learn that meaning could be situated through a variety of ways?

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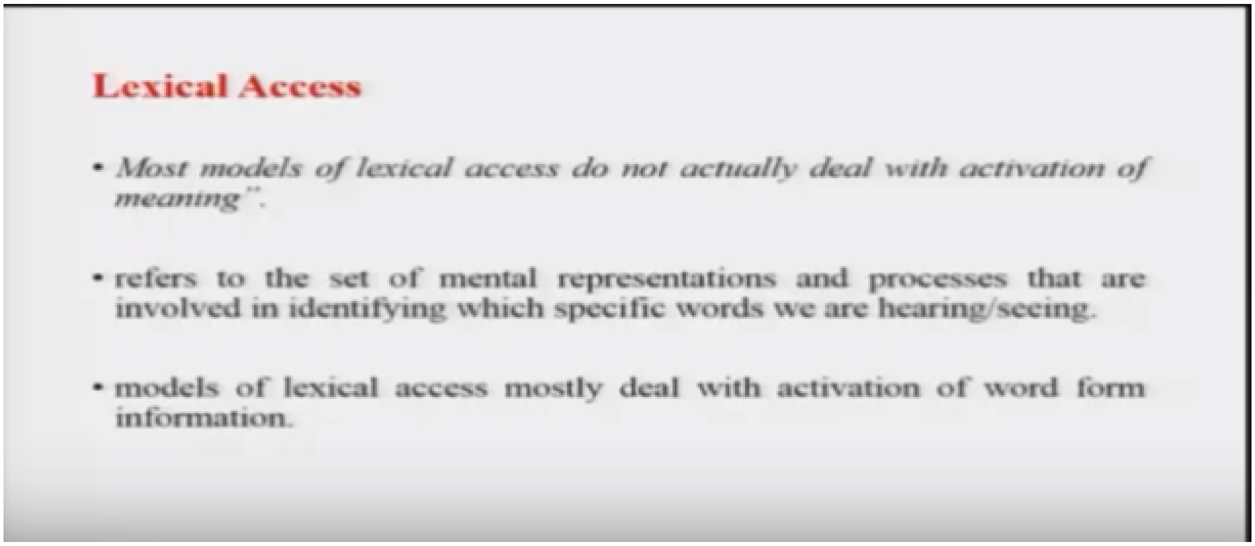

One is there kind of thing other is the lexical access through semantic network, the third was the association and this for theory was grounded cognition, you know embodied manner Okay? So, we've talked till here a little bit about how meaning is you know really done. Let us move to the next part of the words. You know you remember when we started; we talked about form representation and meaning representation. Let us talk a little bit about form representation now. Form representation basically is modeled in something referred to as lexical access Okay. So, models of lexical access basically do not actually deal with the activation of meaning, they don't deal with an activation of meaning at all. The whole point of lexical access is basically the set of mental representations or mental processes, that are involved in identifying which specific words are you going to read, or you know see or hear okay? Which form so for example you're reading a particular word; you have to find a matching form in the brain. You're hearing a particular word you have to find a matching form in the brain. Form Chabad the meaning part that happens. We've already talked about how that happens. Now we are going to talk only about, the part till activation of that form. You know? The part that you have this knowledge okay, okay? I know this word, that part. That is what lexical access is.

So, again specifying models of lexical access mostly deal with the activation of word for information, and not really with the meaning part. I mean the meaning part we'll obviously automatically happen after this all right?

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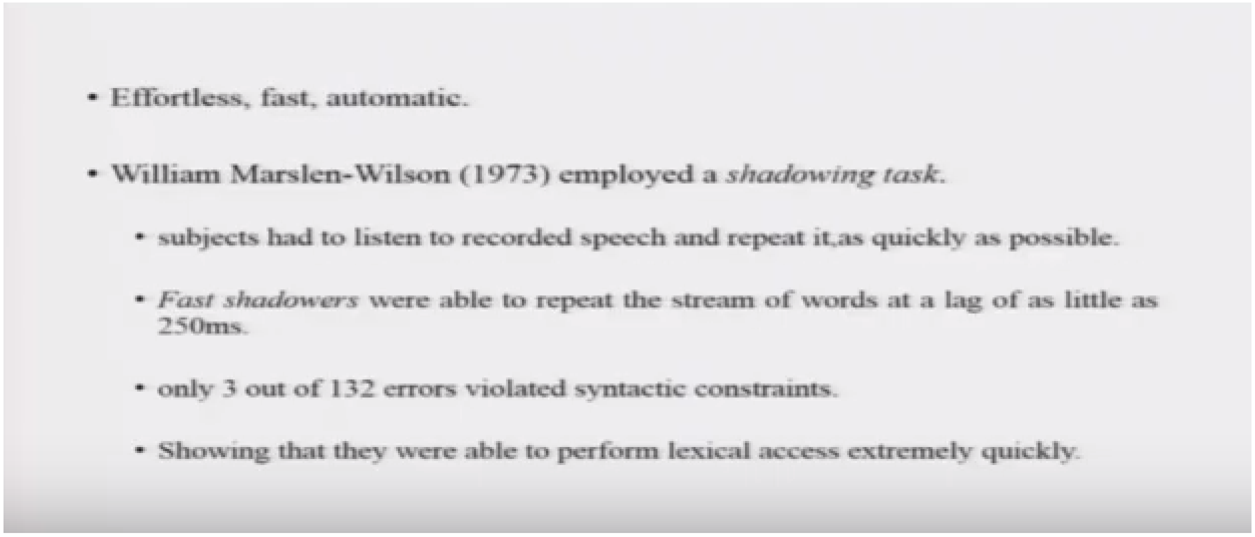

Lexical axis is supposed to be fast, effortless, automatic, as soon as you read a word and if, you know that word in a prior sense this will happen very quickly. Okay? And then there's this sevillio muscles and did this study and, they wanted to check how the lexical access thing happens. He applied this task called the shadowing task. What is the shadowing task? Now basically the headphones are there, and person listen through whatever is being said in the headphones and shadows that or say which repeats that after what are you hearing okay? So, subjects had to listen to recorded speech and repeat it as quickly as possible. Fast shadows were able to the stream of words with a lag of as little as 250 milliseconds. Slow shadows probably do it a little bit slower.

Only three out of hundred thirty two errors violated syntactic constraints. So, very few syntactic errors happened. Showing that participants were able to perform lexical access extremely quickly okay? You cannot speak anything unless you have generated the morphological for logical other things. So, that is what you learned in the speech chapter. So, if people are doing the shadowing tasks, they are probably going from the concept and downwards, that's how speech can happen okay? So, lexical access that is generating the form part is happening very, very quickly. It’s happening as quickly as 250 milliseconds.

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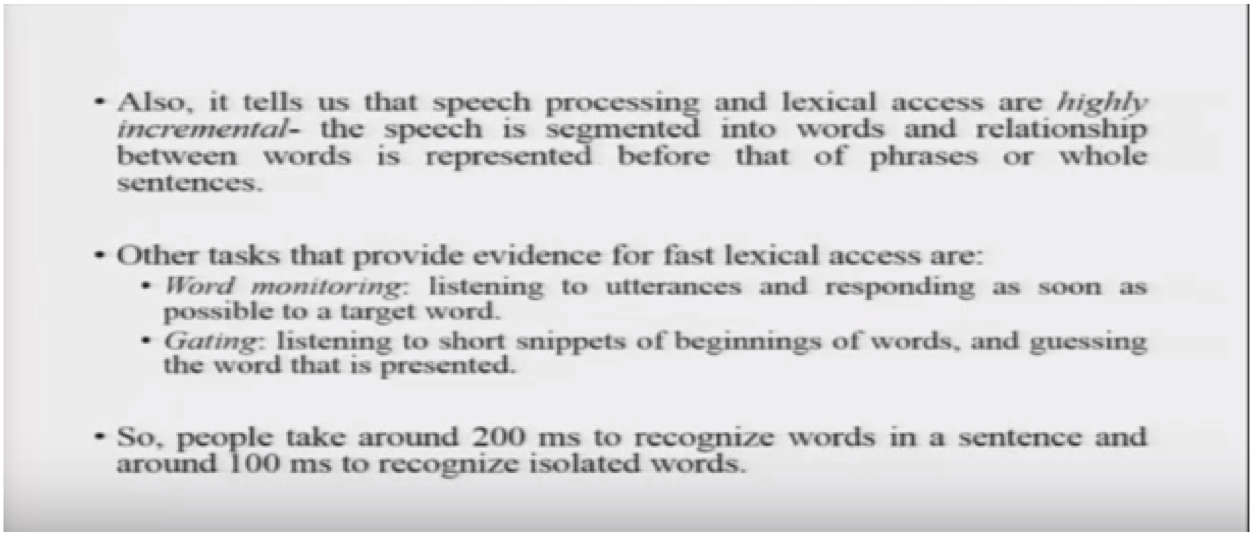

Also, this chair. So, that lexical access is a highly incremental process. Speed Crossing lexical axial both incremental processes. Speeches first segmented into words, and the relationship between words is you know represented before that of the phrases or a whole sentence. The first thing that you have to do is you access the form of the word, then you access that of a phrase, then you access that of a sentence. So that is an incremental process. There are other types of tasks, that also can be used for if people want to study lexical access. One of them is the word monitoring task. So, word monitoring task is very simple.

You are listening or screening utterances and responding as soon as a possible target word comes. You look for it in your mental lexicon. I shall do I know this word is this the word that I am looking for as soon as you do it you press the key. The second is gating. So ,you listen to short snippets or the beginning of you know short snippets or the beginning of words, and you guess what is the word is that is message as I soon as soon as .I say um you would know ,that the other word is umbrella. So, that is called gating okay? It has been shown that people take almost around 200milliseconds to recognize the words in a sentence, and even faster around 100 milliseconds to recognize the ends of the word okay? So, this entire process is probably happening very, very quickly. You take very little time to reach the form of that word. All right? Now people have modeled this process of lexical access in many ways. I will talk to you about the first second and the third generation models. I don't know what portion I will cover in today's lecture.

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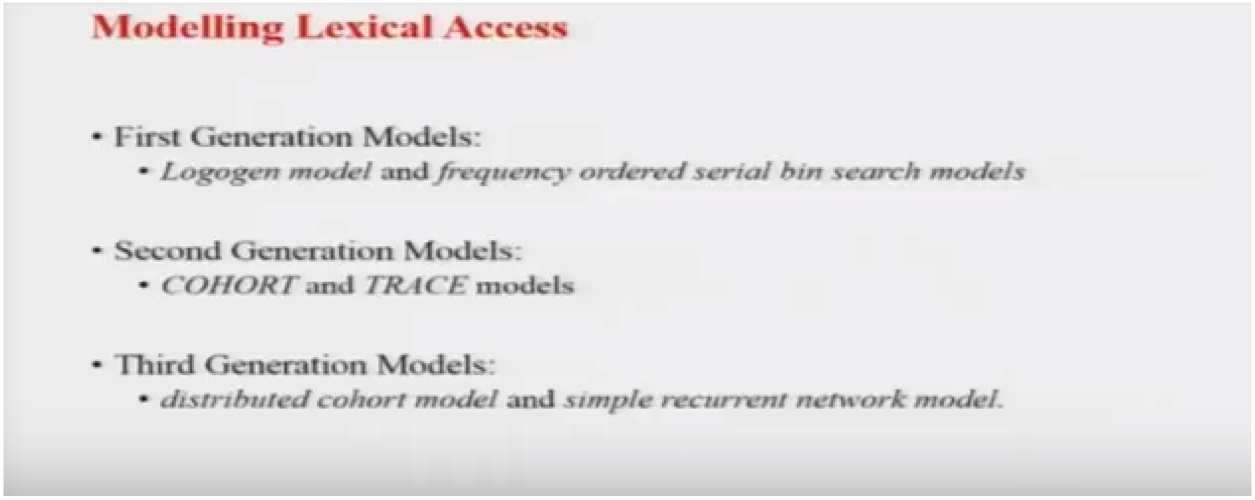

So, the first generation models are the logos in model and the frequency ordered beam search model. Then they're the second edition models the cohort and the trace model, and then there's this third generation models which are covered in the distributed cohort model and a simple recurrent Network model.

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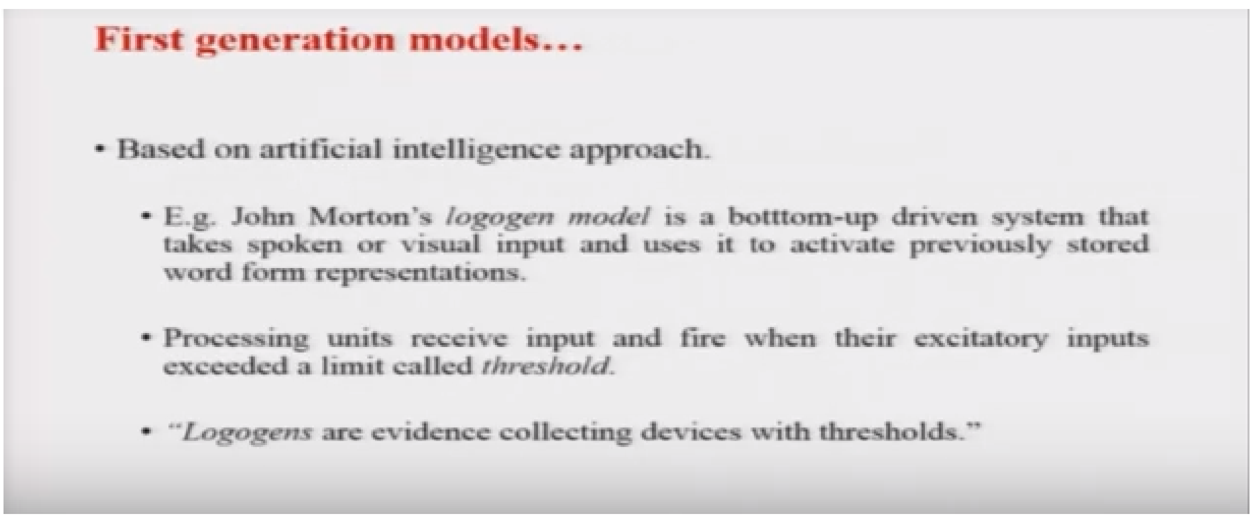

Let us move to these models already. The first model is John Martin's Logogens s model. It is the first generation models. One of the earliest models. It's probably happened in around

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- Each word is represented by a corresponding logogen in the model, words are recognized when activation of logogen crosses threshold.
- Logogens derive input from spoken words, written words or preceding context.
- The logogen system operates on these three kinds of inputs and, when individual logogens become activated above thresholds, they send signals to an output buffer.
- Unless new input continues to activate the logogen, a decay function returns its activation to baseline levels.

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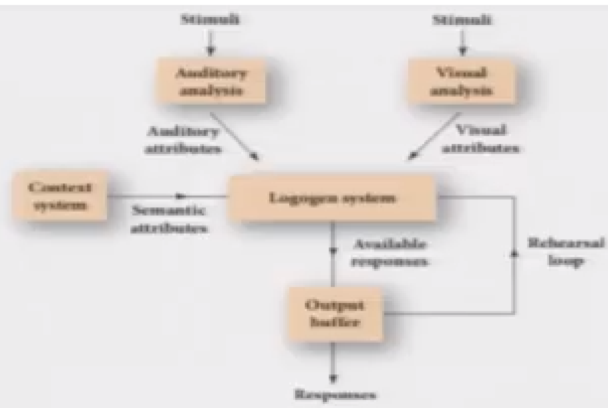

Image: Traxler (2011) John Morton's Logogen Model (Fig. 3.11; Page: 100)

I think 1969 or so I don't have the exact date. John Martin's Logogens s model is sort of a bottom up driven system. That takes a spoken or visual input and uses it to activate previously stored word form representations. So, using this Logogens s model you already should know the word and what this model will do is? It will take up input and it will evaluate that input as to whether you know this word or not? How will this evaluation happen you look in your head? You look say for example, whether I know this word or not? So, basically it takes this word. It’s kind of you know a built up incremental input and it matches this input to whatever representations you have in your head. The thing with which this input really matches is recognized as a word. That is what is happening.

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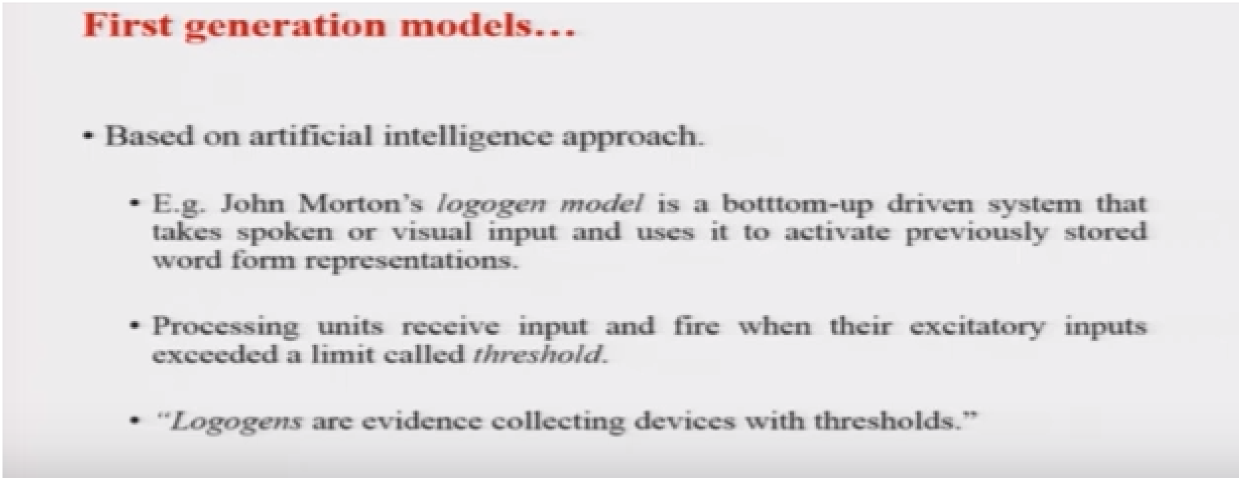

So, John Martin's Logogens s model. The processing units are is called Logogens s. Each Logogens represents each word, and Logogens s basically are going to look at them as evidence collecting devices. So, typically if I were to draw, I will draw this kind of a little thing you know you have these bars when some work is happening now you're transferring some file from you know one system to your system there's this bar in the bar eventually it keeps getting filled as soon as the entire thing is done. So, this is an evidence connecting device. As soon as, the evidence reaches 100. This entire bar becomes clean. Their evidence is 50% the bar is 50% green and 50% gray or something like that. So, you can look at Logogens s as those kinds of things. So, Logogens are evidence collecting devices, and evidence is obviously incremental in nature. At least for as far as speech is concerned in you know in written form yeah everything is just there right at the moment, and you have kind of you know when you're reading, you're developing evidence. But in speech the evidence automatically is unfolding in time. So, the evidence is building up over time.

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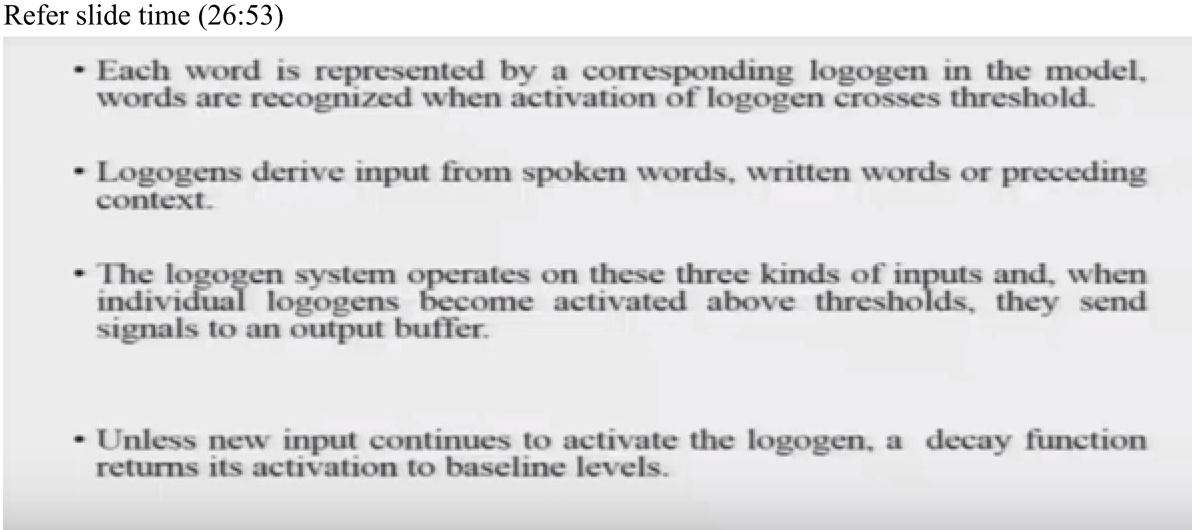

Each word as I said was represented by Logogens in the model. Words are recognized when the activation of the Logogens crosses a particular threshold. So, the Logogens s are collecting evidences, and when this evidence collection reaches a particular threshold that is where you will recognize a word. So, as soon as the evidence reaches a particular point and you're sure that this is the word that I already know. That is the point where which is referred to as the threshold. Logogens s as I said derive input from spoken words, written words, are also preceding context. What word will be said now? Suppose I'm talking about cricket and the conversation is about cricket and batting and so on and so forth obviously at some point, I will refer to this particular thing. You know that, which word is going to come up. So, the context also kind of is a very important source of evidence for what word is going to come up in the conversation next. The Logogens system operates on three kinds of inputs you will see and when individual Logogens becomes activated above thresholds. They send out signals to the output buffer. Where in you kind of say yes, I recognize this word, or you have to take the name of the word you can take the name of the word okay. Another very important thing is unless new input comes in and continues to activate the Logogens a decay function kind of return on the low version to its previous level. So, you read particular set of words, all of them become activated, after that you didn't read those words for days and weeks and at once. So, obviously the activation will go down. Okay?

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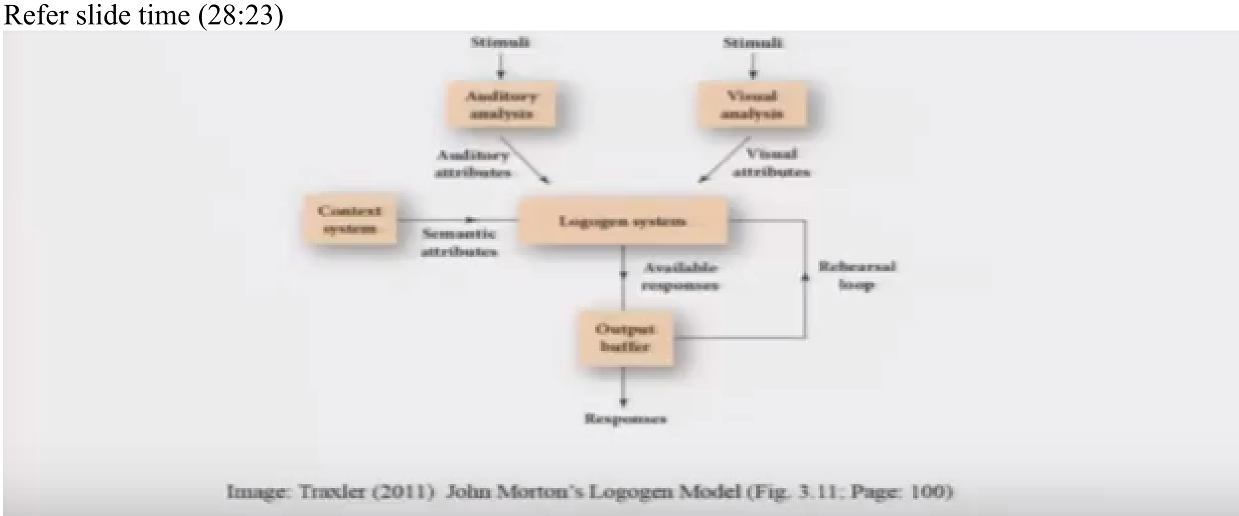

Image: Traxler (2011) John Morton's Logogen Model (Fig. 3.11; Page: 100)

This is the architecture of the Logogens system. You can look at its stimuli can come from either the with auditory side or the visual analysis sides, you can kind of look at the auditory attributes, or the visual attitude and there's this Logogens system. Which has these you know each Logogens kind of is collecting evidence for each word. So, you have as many Logogens s as an Evo, yeah! Okay? And there's a rehearsal loop, there's this context system, which is giving semantic attribute that. This is the most likely word from the semantic point of view. Suppose say for example, if I am talking about bat, in the cricketing conversation, I am not talking of the animal bat. You know? Even though they have the same form and they kind of are effort by the same for the logical form you know for sure that I'm talking of the bat. That is the instrument is used to play cricket with, but not that particular you know animal. So, that is something that is there okay?

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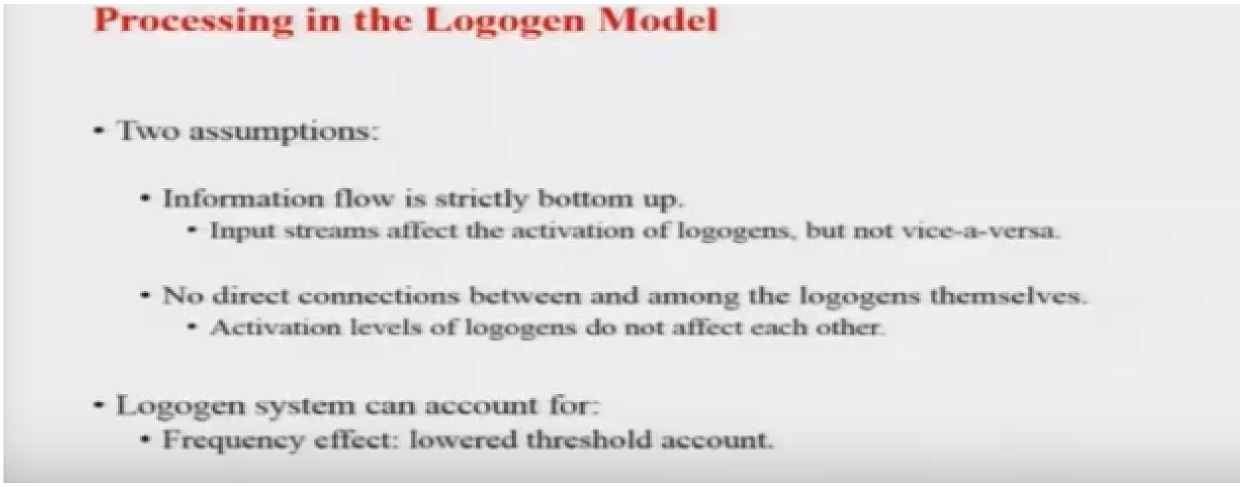

So, how does processing happen in the location model there are two assumptions. Information flow is strictly bottom up. So, as soon as the input is developing. That is what is feeding to other portions. So, this input is in very incremental and bottom up in nature. Second is there is no direct connections between and among the Logogens s themselves. So, each Logogens is an independent unit in itself, and there's no connections with. So, it's not like the semantic networks theory. That we talked about okay? There’s one Logogens for each word that you will speak, and as soon as the input for that Logogens kind of process threshold you will recognize that wouldn't you be able to speak. That word their activity in this Logogens will not be affected by the activity in any other Logogens around it. Okay? So, the Logogens system can account for a variety of effects. One of them is the frequency effect. What is the frequency effect? If I might remind, the frequency effect was that words with higher frequency are responded to faster than words with lower frequency. How does the Logogens system account for that? The Logogens system says that high frequency words because they are you know being spoken more often than the other words ,that the amount of evidence residual evidence there is .You know is already there ,and basically what happens is that the threshold slightly becomes lower. Because the threshold becomes lower, you we need just a little bit more of the evidence to be sure that this is that word. Okay? You remember that study I always talk about, that you know there was this experiment going on people who are listening you know in their headphones and the word was the you know etc, etc. About legislators, and then there was this coughing sound exactly at the place yes. But you know about legislature is a highly frequent word. You with the basis of that incomplete input you could still say that you know legislators was the word that was said. Okay?

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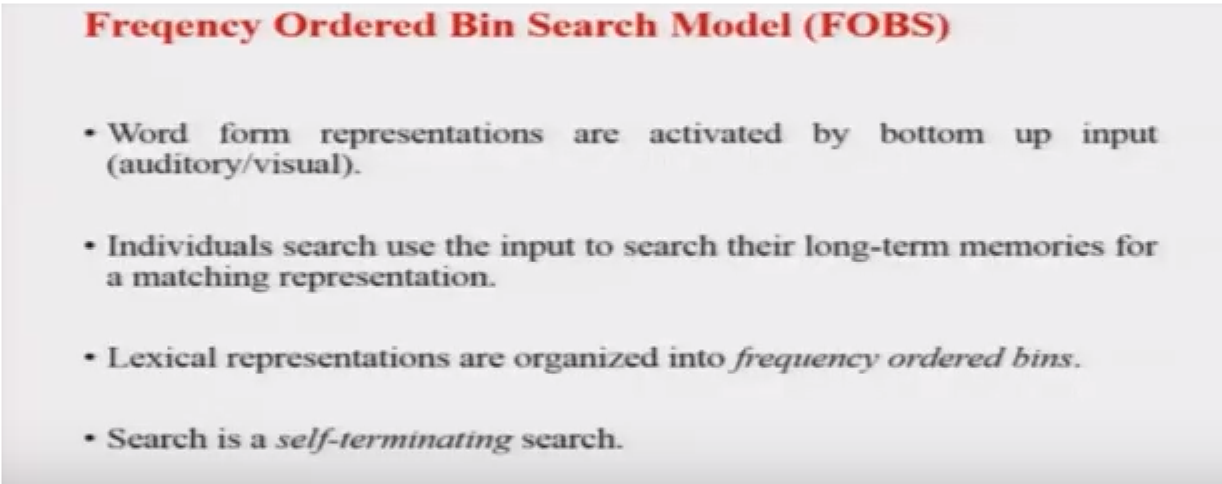

Let's talk about another model. The frequency ordered bin search model. There it is a different kind of a representation than the Logogens model. The frequency ordered bin search model basically, represents information again in a similar bottom of kind of way. But basically, words are organized in this on a different principle. The principle which the frequency ordered bin search model uses is that of morphological organization. So, what is there is that words are organized into bins, by their you know respective root words. So, for example the first thing that happens is, that you organize the word you morphologically decompose a word as soon as the word comes in, and you decompose the words into a root morpheme and into you know a suffix of that. Suppose ever jump layer the root morpheme is play blackboard the root morpheme is black something like that. So, you basically make bins regatta you know with respect to those roots. Within those so for example the you know there will be a bin called play. In which plays their player is there, played is there, playful is there, playing is there. In this in the bin the organization is by frequency, and how do you count frequency? as soon as you say for example say play, you count it as one you say player, you count play as two, and player as one, you know and as soon as you say playful, again in the same bin play has even higher frequency and play, play, playful just as one .So, the idea is the root word will always have a higher frequency as compared to the surface words. So, this is root frequency this is surface frequency see root frequency is always going to be higher than surface frequency. So, you kind of keep these two things in the same bin. In the bin the root word will be at the top most easily accessible, and you know the champion of this competition. So, this is this is what how this basically really happens, and you talk about morphological decomposition. I told you that there is a free morpheme, bound morpheme and there are derivational morphemes all sorts of things .Typically what is happening is a word comes you broke break it down into morphemes and you are you know put the root morpheme in charge of one bin, and every other derivational inflectional forms will all come in. But the root morpheme will be the master of that most easily accessible member of that particular bin. Because it has the highest frequency.

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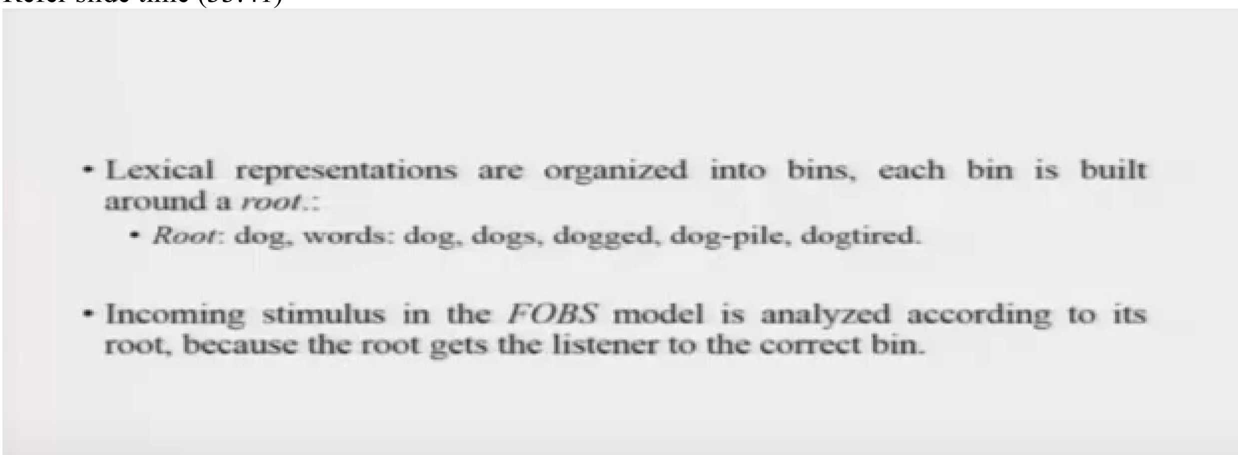

So, hardest processing will really happen. If you are searching the search will be a self terminating search. As soon as, you find that particular target word the search will stop. Lexical representations as I said as organized into bins each wind is built around a root. So, you know play player playful playing all of that. Incoming stimulus is modernized is organize is analyzed according to its root. Because the root gets the listener to the correct bin. All the inflectional derivational kind of forms are there.

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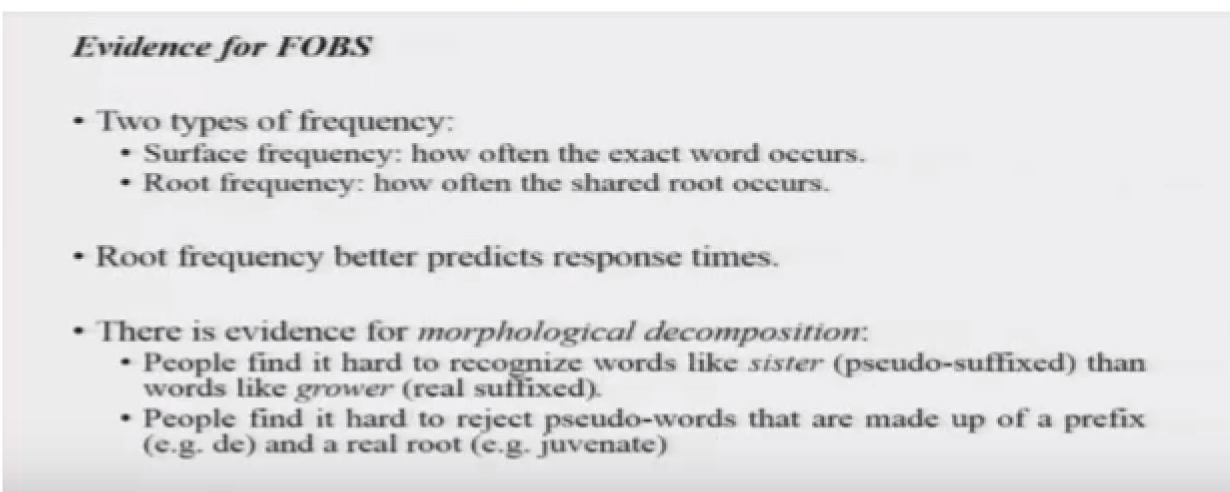

Is there any evidence that we do that apparently there is? There are two types of frequency as I already said, surface frequency, root frequency. It has been found that root frequencies better predict response times. So, it’s kind of can be taken a little bit of an evidence that yes people are using the root frequencies roots to organize their or you know the words in the network in the mental lexicon that is. Also, there is evidence for morphological decomposition. Say for example it has been found that people find it harder to recognize words like sister. Why sister as compared to grower because if you kind of this word sister comes in, in the fobs model you will break it into sist and er. Because you know that it is a particular for morpheme and you start looking for a bin with sist and you'll not find it, then you'll again come back combine this and then start looking for this word sister.

Because a morphological decomposition part is by default applied to every word that comes in. Because the system would have come across ER as a particular kind of a morpheme, it would have broken down sister into sister, and here but then later they found that there is no bin labeled with sis it will recombine it and again look for it, and this will spend a lot of time as comfort as compared to the simple word like player or grower as soon as, you break this noun into player you go to the root morpheme of play now you go to that bin and there you find player much faster as compared to how you found sister. So, that is again one evidence for this,

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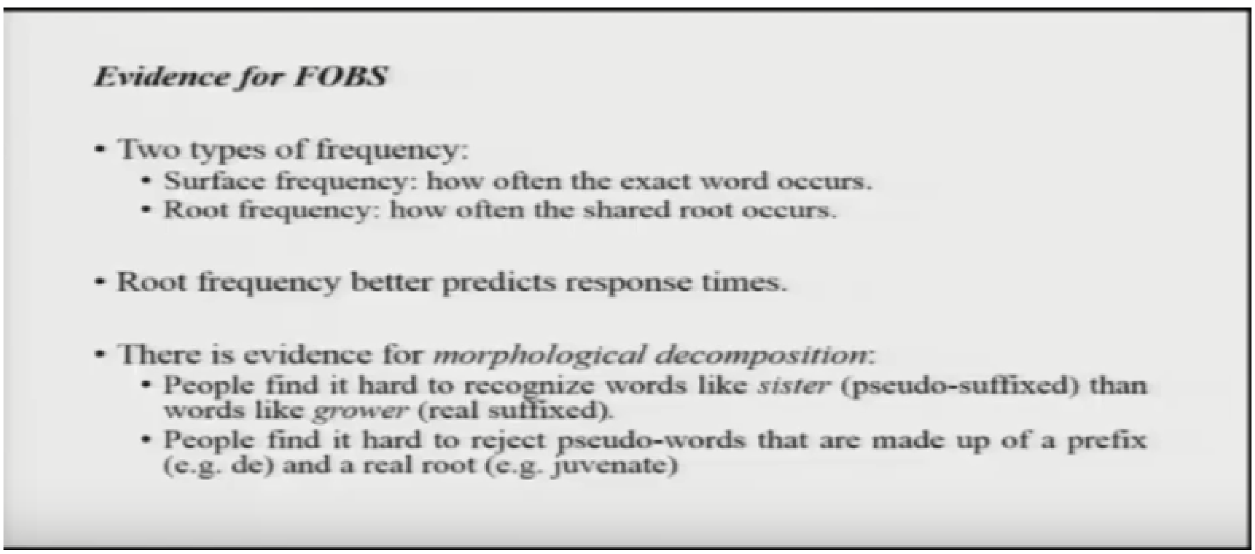

and the other kind of evidence is, that people really find it hard to reject pseudo words that are made up of a prefix, and a real root, a false prefix and a real root false prefix could be de, so you know there's a word called rejuvenate re is the prefix, juvenate is the root word. Suppose, I give you a give the system false word like, rejuvenate the system will again happily break this down into de and juvenate, and then it will kind of reach the bin for the root word juvenate, and start looking for rejuvenate there, it will not find rejuvenate there, and because there is no word called rejuvenate, however if it, were rejuvenate you will quickly find rejuvenate over there. Okay? So, this kind of this time that people take in rejecting these kind of pseudo words these kinds of false words, also tells us that may be people are doing the morphological decomposition and that is what is leading to these problems.

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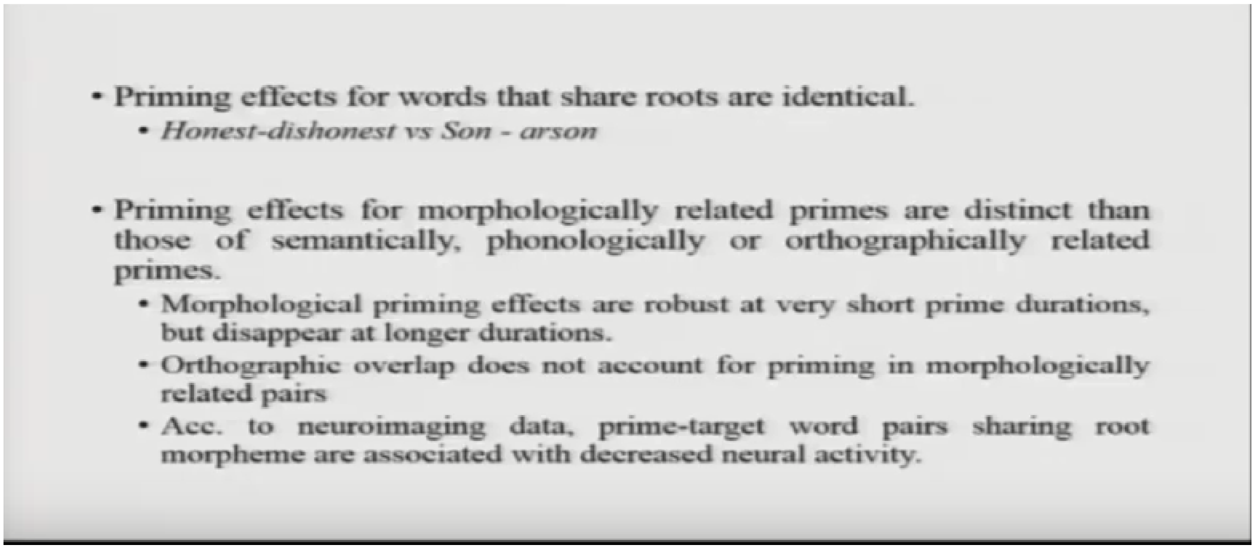

Another set of evidence for the morphological decomposition or the folks model comes from the fact that people have a priming effects for words that shared roots shared roots are identical so, honest versus dishonest the shared root is there the word honest is the shared root, so the priming here is faster as compared to Son verses arson this even though phonological it is similar the arson cannot really be, you know divide it into R and Sun because that's, that we will lead to an incorrect classification. So, son and arson is not really going to work but honest and dishonest is going to work and people will experience priming for this kind of setup.

Okay? So, these kind of priming effects that we are seeing in the morphologically related crimes these priming effects are slightly different to the semantic, or the phonological, or the orthographical priming that you will see in this entire course and different points in time. Phonologically priming is by virtue of sound semantic priming is by virtue of meaning, orthography priming is by virtue of form. It might overlap a little bit with the morphological priming but, morphological priming is basically because of morphological components being shared so, that is something that you should remember. Morphologically priming effects are were found to be very robust, and work at short prime durations orthography overlap does not account for priming in the morphologically related part so that, is also there Okay? According to the neural imaging data it has been shown that prime target word pairs that share a root morpheme are associated with decreased neural activity so, there is some sort of a relationship there at the level of the brain.

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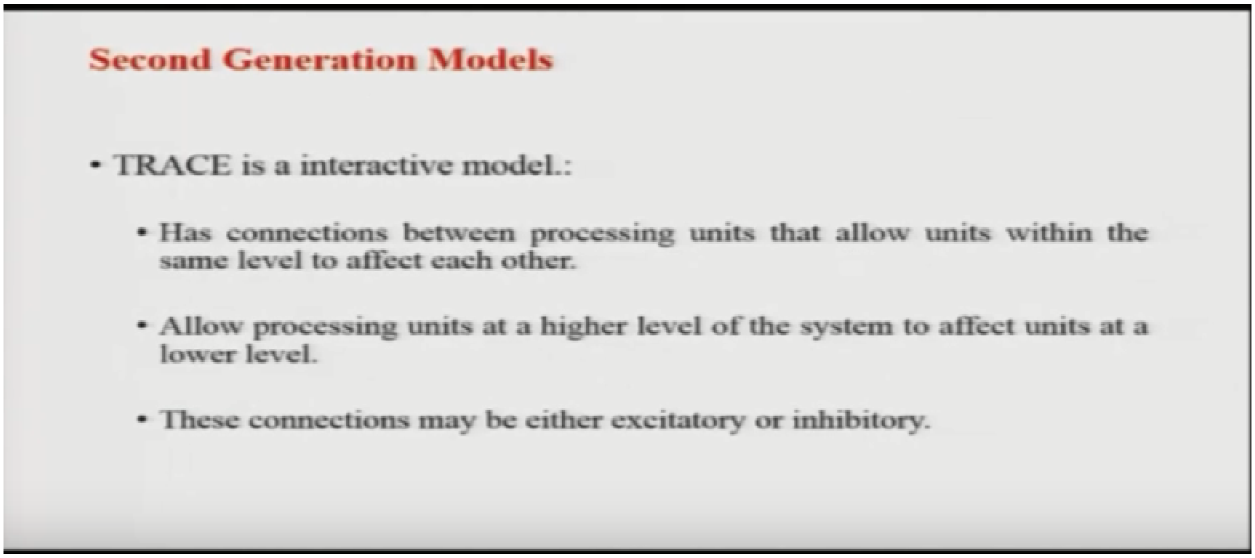

As well alright, so let us, move to the second generation models I, probably covered this model a little bit so, this is referred to as the trace model the trace is a model of visual word recognition so, it basically is about how you read words,

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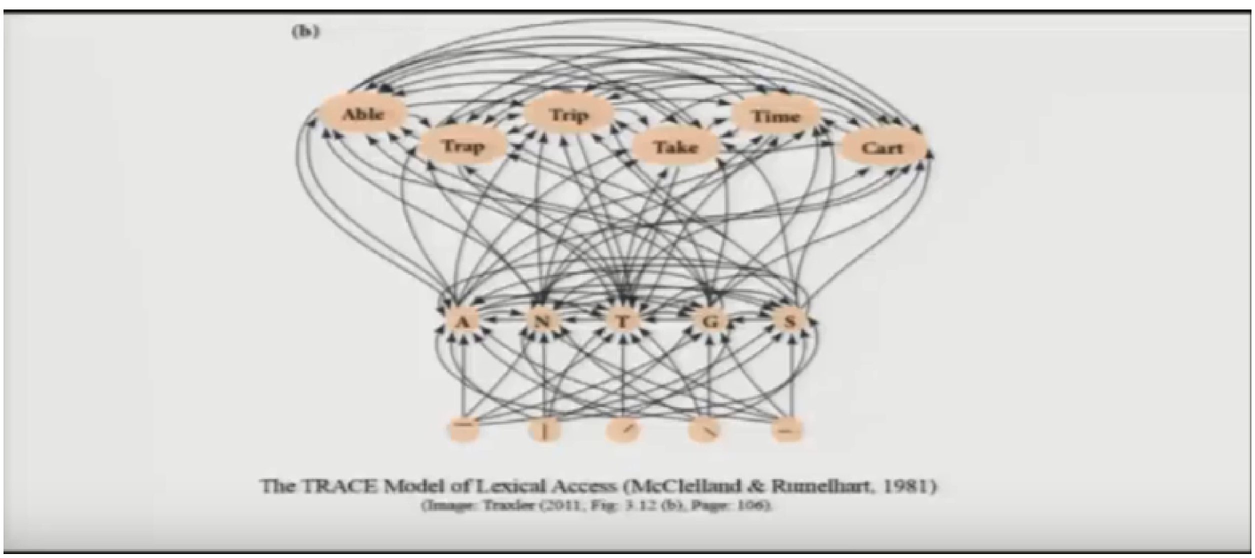

this is one of the models that McClellan and Rumelhart came up with wrote that book called, ‘Parallel Distribute Processing’, in the 1980’s and this is how this model look like, so you have at one level features, another level letters,

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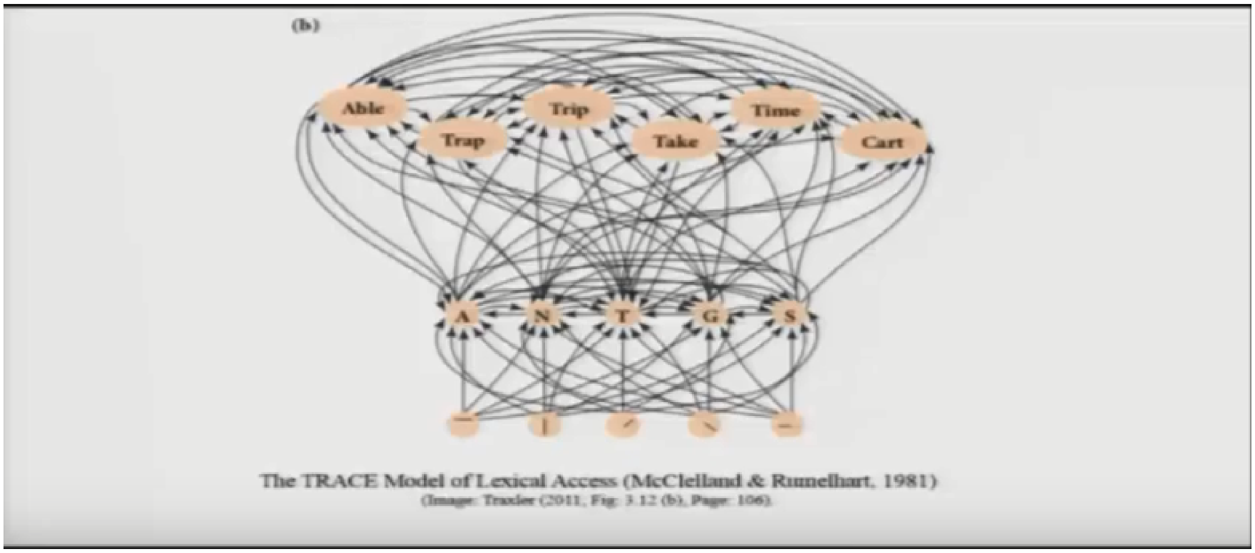

and another level words. Okay? This is the model that you will see there's a lot of feed forward and a bit of a feedback as well at least between the word and the letter level.

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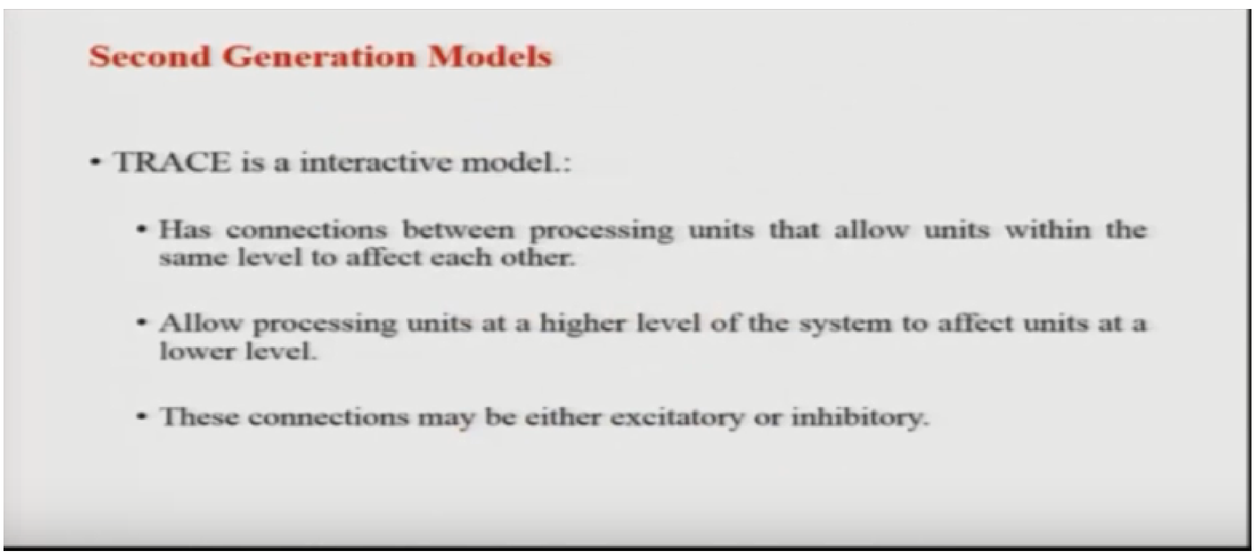

So, what is happening here is the trace is an interactive model that's why they are both feed-forward and feedback connections, it has connections between processing units that allow units between the same level to affect each other you can see that the letters are also connected to each other, and the words are also connected to each other.

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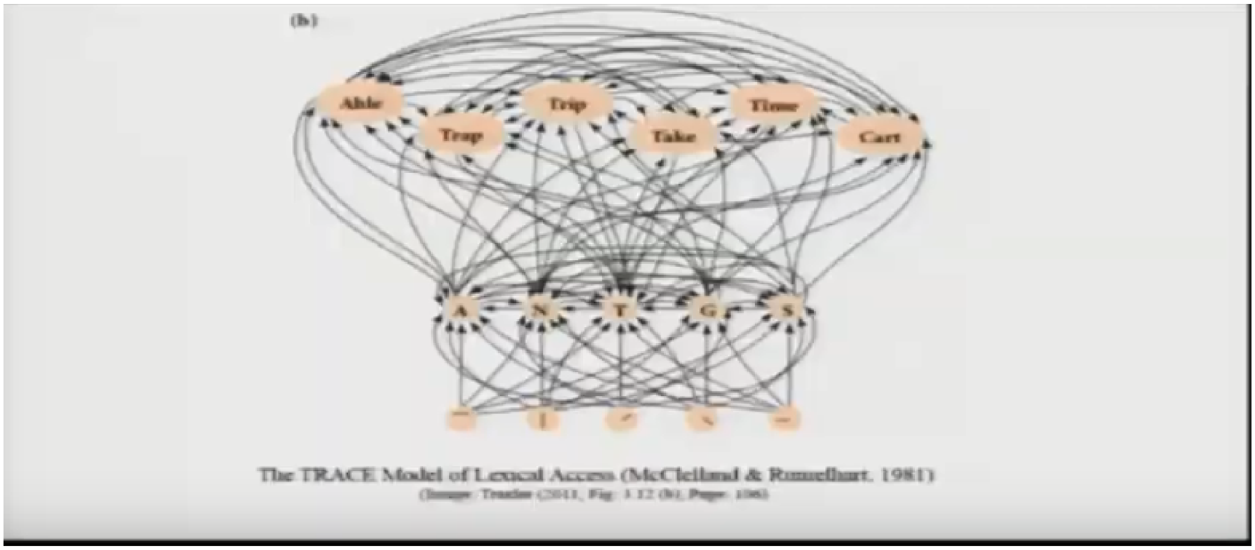

All right,

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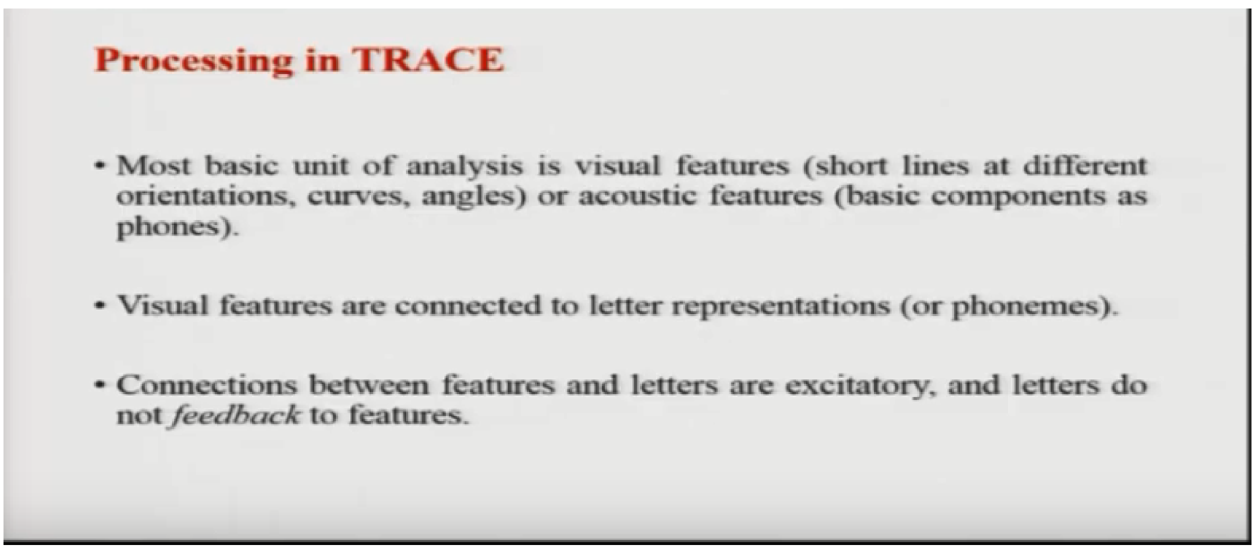

also say for example, yeah! The processing units at a high level can affect the processing units at a lower level, there is also some kind of feedback from a lower level, which is the letter level to the word level but no feedback from the feature level to the letter, that's all so, there you have to remember that these connections between these you know combination these levels can be either excitatory or inhibitory.

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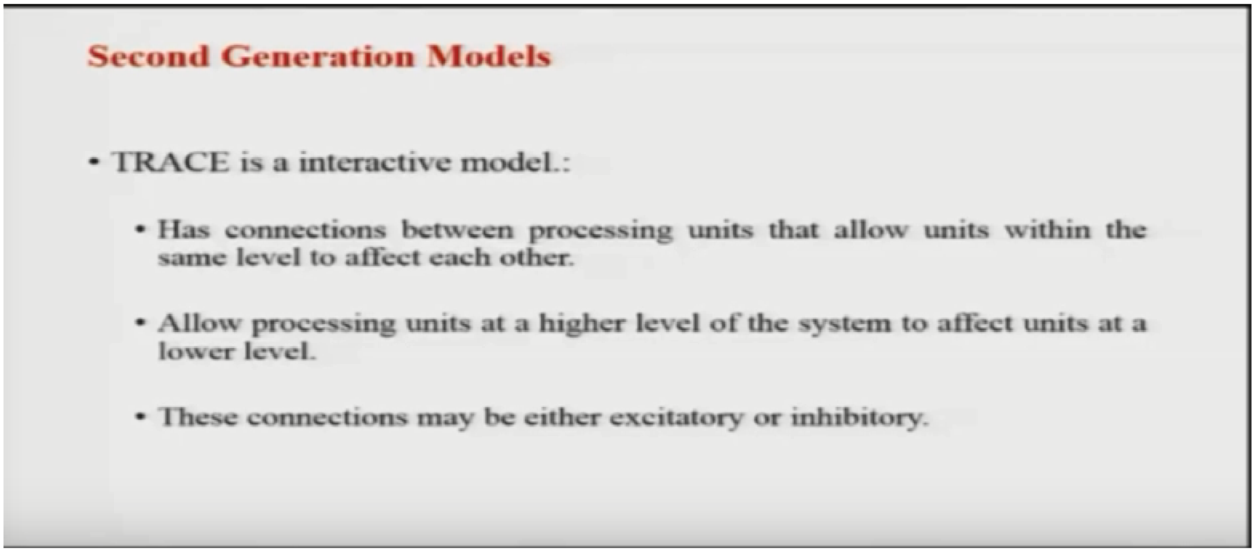

There's also something that one needs to remember,

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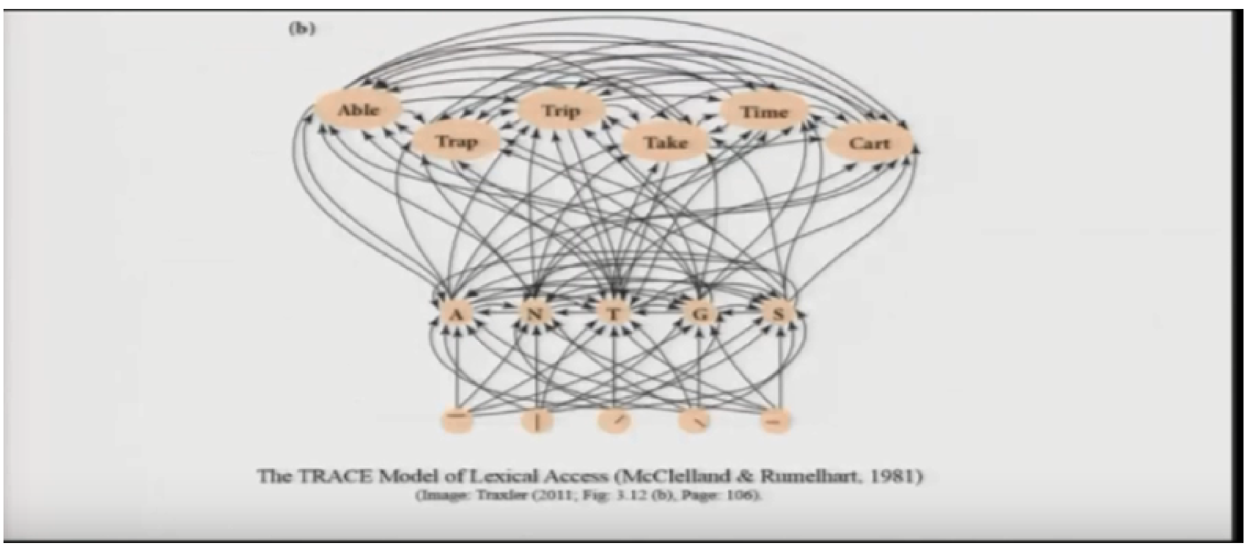

I would suggest that you look at the architecture in some detail, this is how this happens

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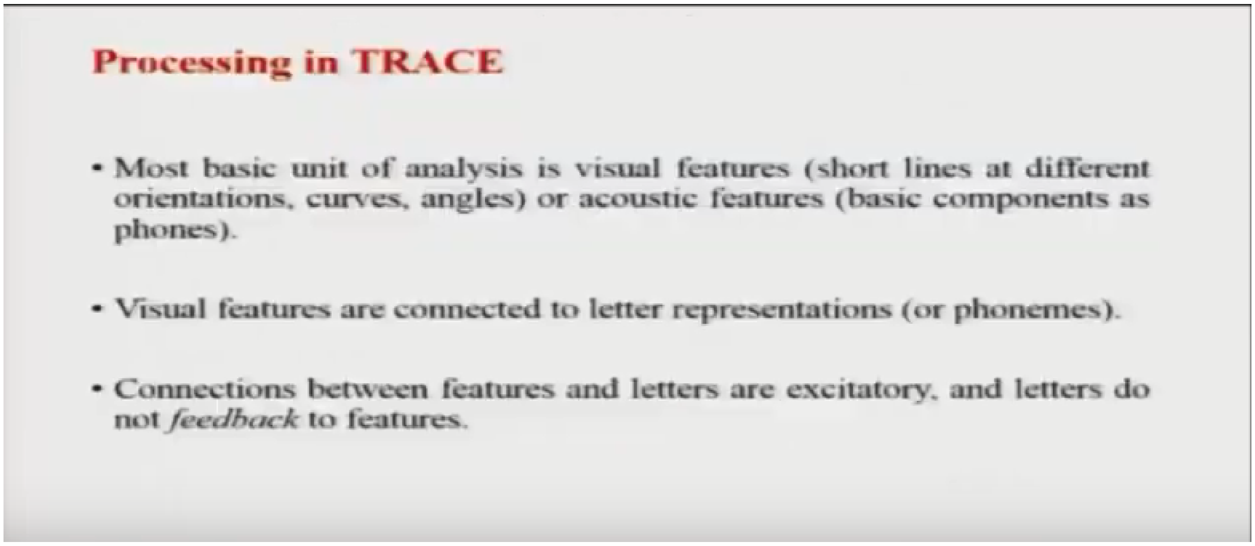

and then let us look at the processing that happens in your trace model. Now the most basic unit of analysis when you look at a visual word his features vertical lines, horizontal lines, slanted lines semi curved structures, and so on and so forth. In a speech in an acoustic form it's the phonetic features Okay? So, visual features you see in this model are connected to letter representations.

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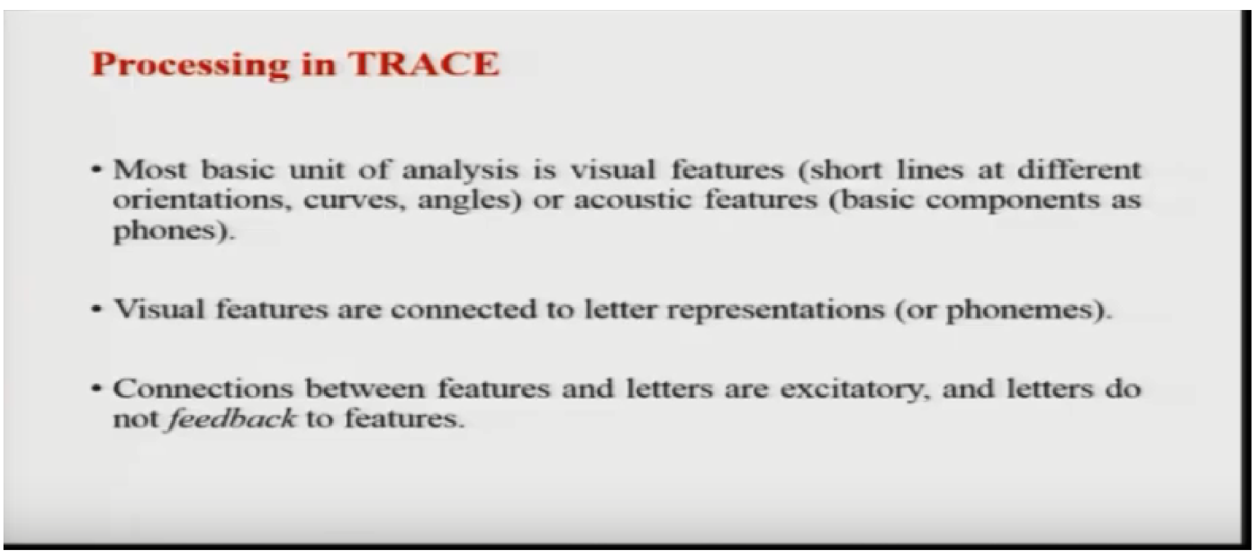

So, for example, a letter T has incoming representations from this vertical line, and the horizontal line he has incoming representations for three horizontal lines, and one vertical line and so on.

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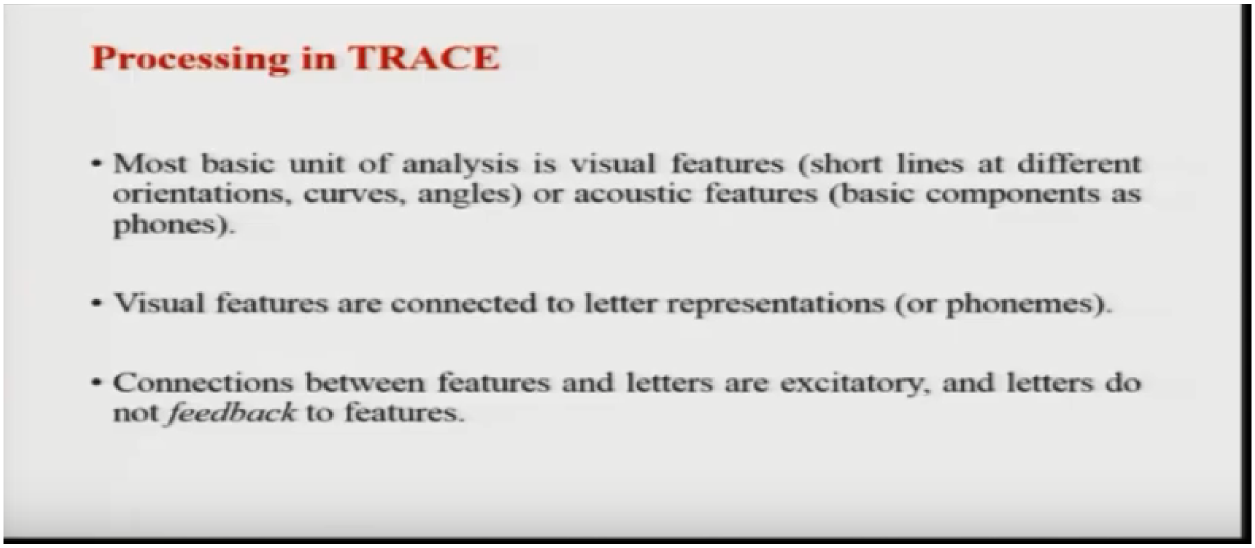

Connections between features and letters are always excitatory and letters do not feedback to features, because feed backing there will probably pre end of the letters so, you don't really want that so, letters do not feedback here, but and the connection between features and letters is straightforward bottom up and excitatory in nature.

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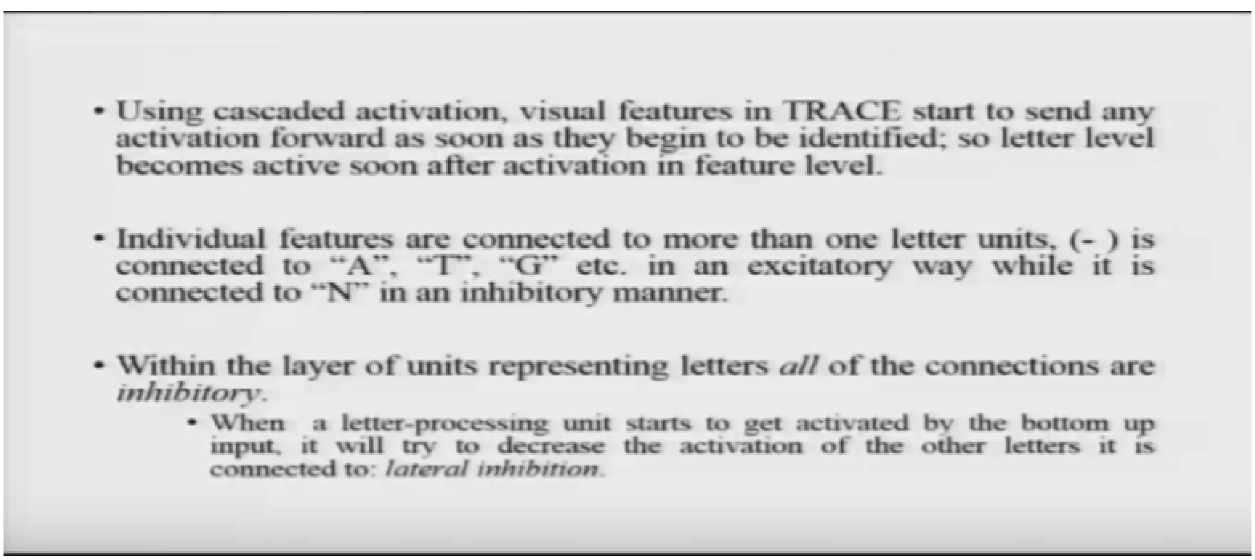

Using cascaded activations visual features in trace start to send any activation forward as soon as they begin to be identified and so, later level becomes active as soon as, some information starts getting accumulated the feature section and the letter level already starts activating some possible words, because this manner of activation is cascaded in nature cascaded basically means as soon as information will come here some of it will pass down here, to the other levels as well.

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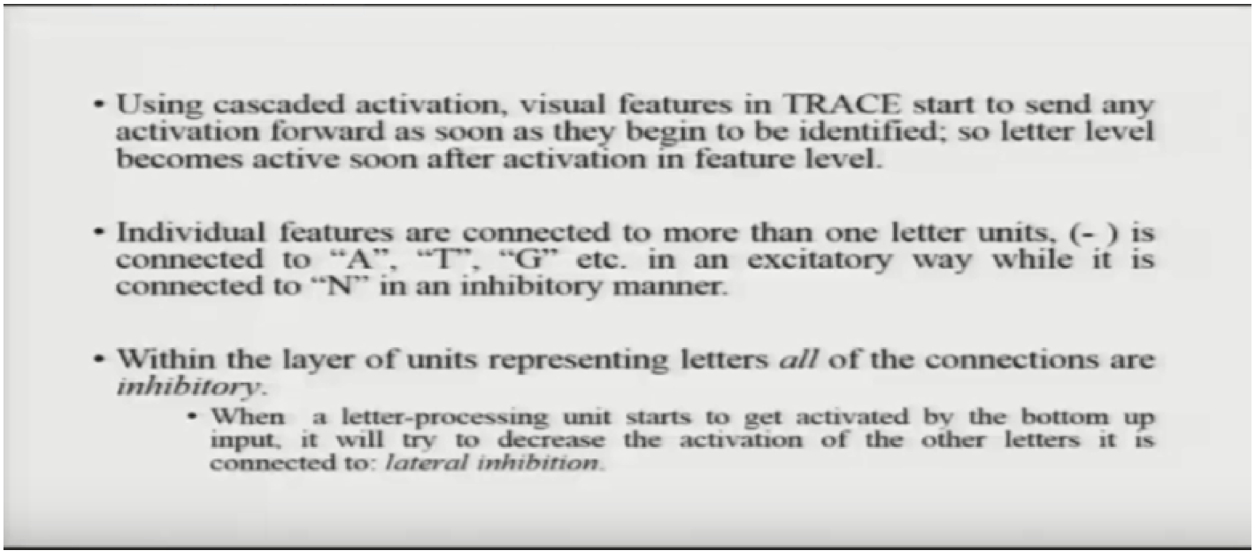

Individual features are connected to more than one letters sometimes, say for example, a horizontal line is at least available in ATG etc, H etc., and while it is connected to N in an inhibitory manner so, there is no horizontal feature in N and M so, that's why this will be connected in an inhibitory manner inhibitory basically means, it will suppress the activation excitatory means it will you know facilitate the activation, increase the activation.

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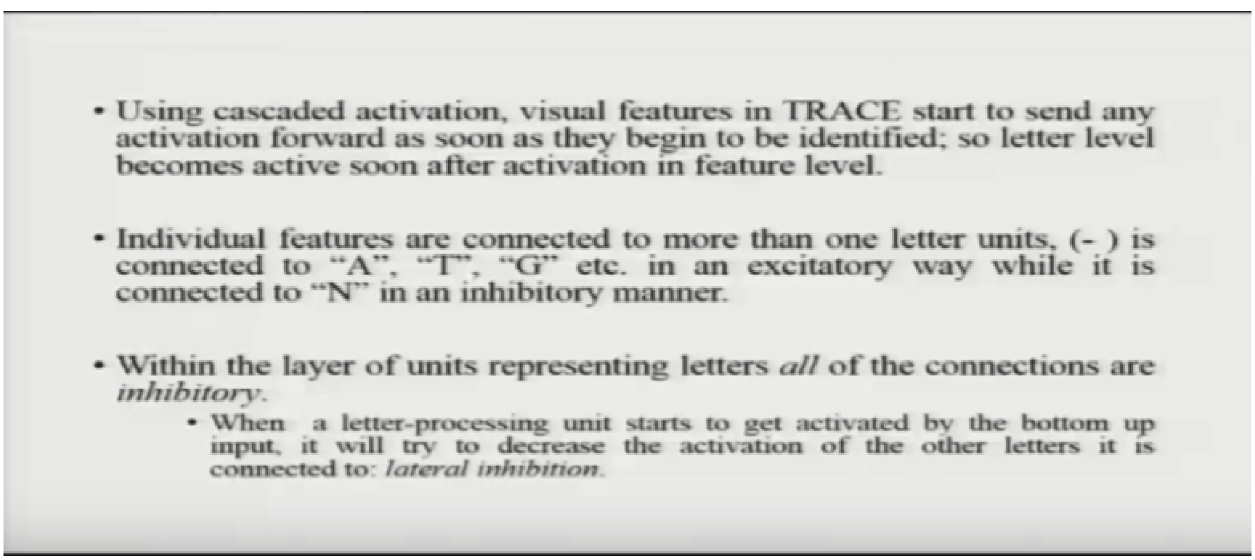

Within the layer of the letters you will see there's not

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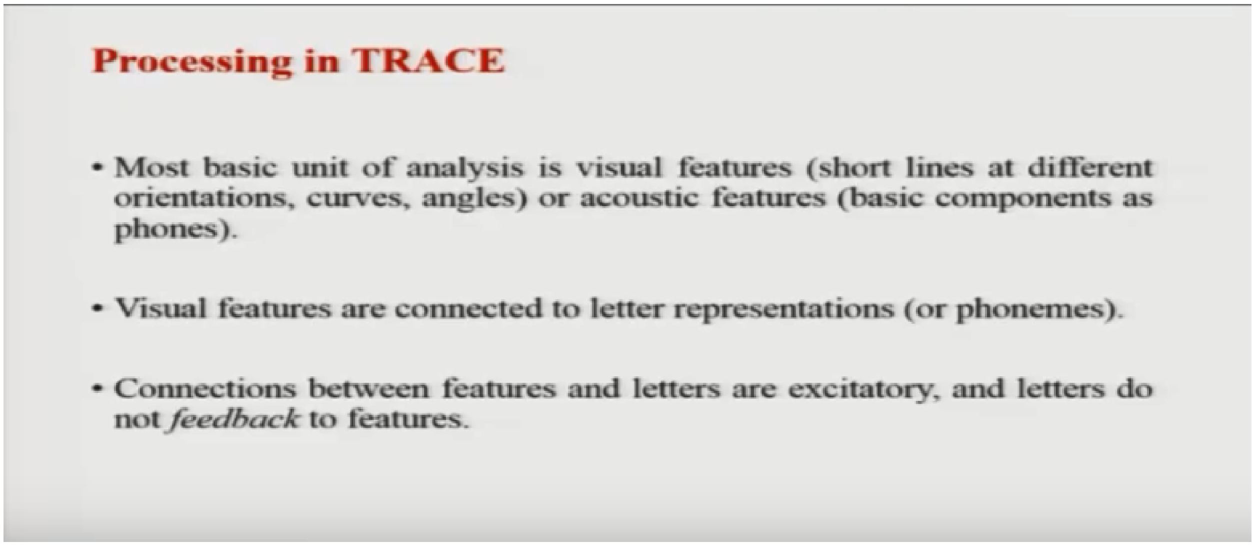

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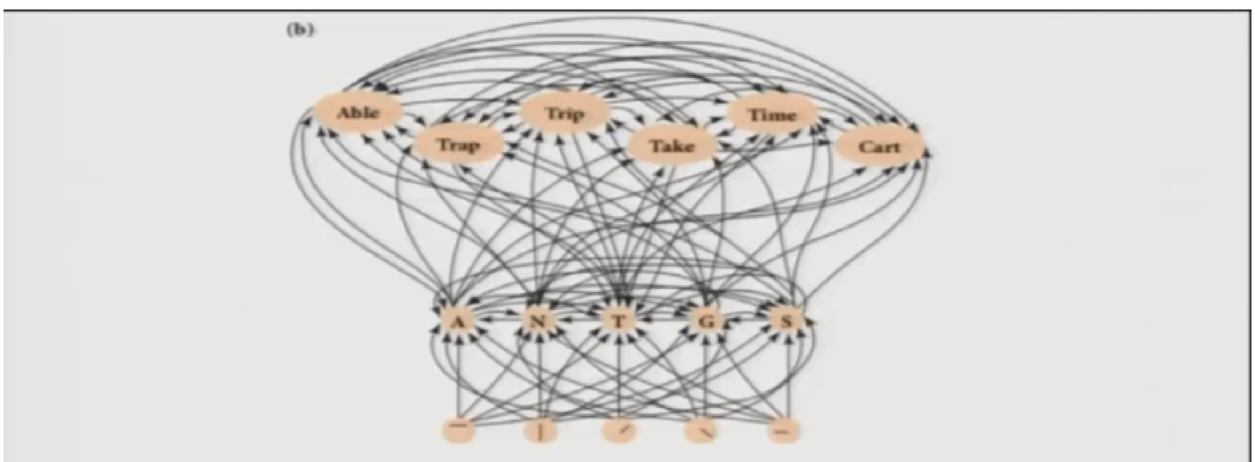

The TRACE Model of Lexical Access (McClelland & Rumelhart, 1981)
(Image: Traxler (2011; Fig: 3.12 (b), Page: 106)

Many inhibitory conditions are shown there but basically what happens is A will be connected to N will be connected to P in inhibitory fashion Okay? Because each of the letter wants to you know win this competition of who will get activate it first so, in the in the in the same layer you will see that there is this mutually inhibitory connections that are there this mutual inhibitory you know

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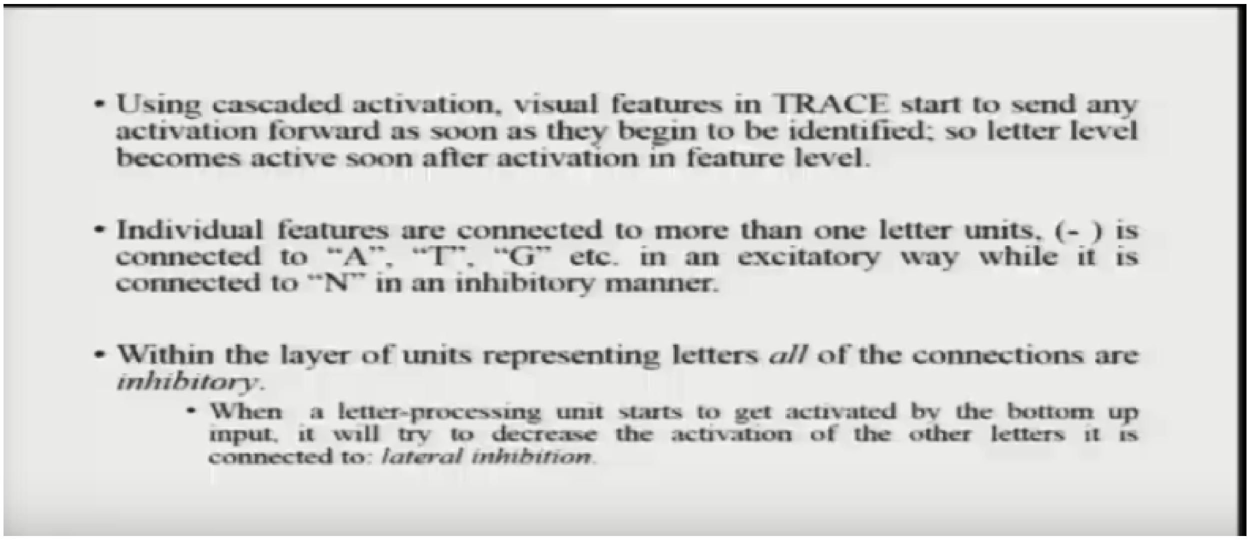

Connections at the same level is referred to as this concept of lateral inhibition, this is something that kind of helps us take care of a lot of competition that builds up here. Let us have excited to the connections

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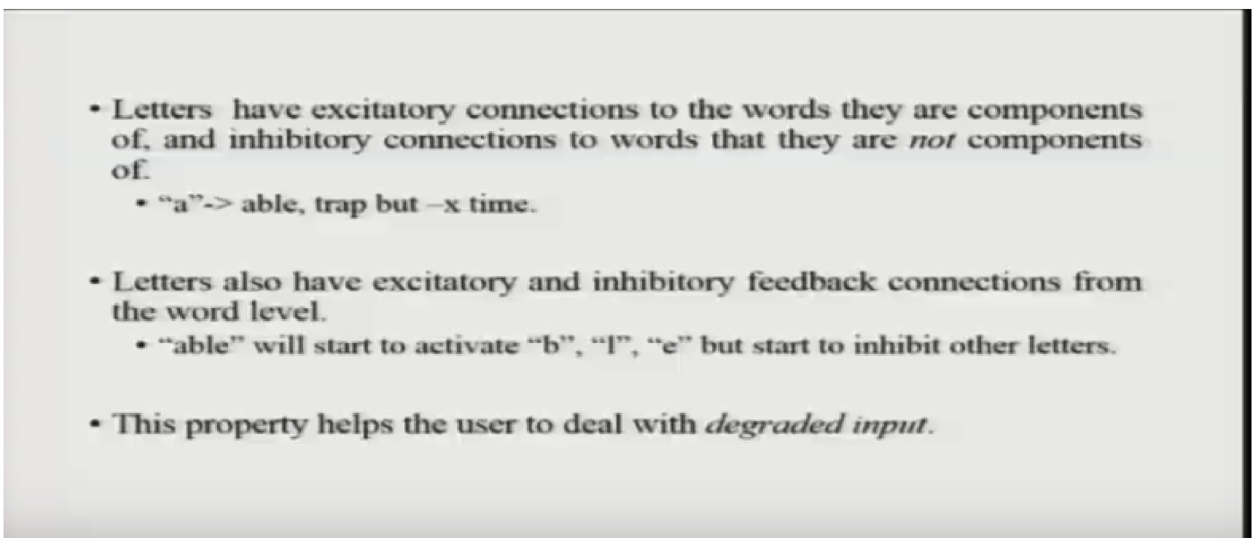

to the words it feeds upwards the input that the evidence that is building so, they have excitatory connections to words that they are part of and have inhibitory connections through the words that they are not part of say for example, A will feedback in an excitatory fashion to able entrap but it will feedback it will feed forward in an inhibitory manner to the word called time. So, A will activate table and trap and table and cat but, it will you know suppress the activity in words like time and rhyme and time Okay?

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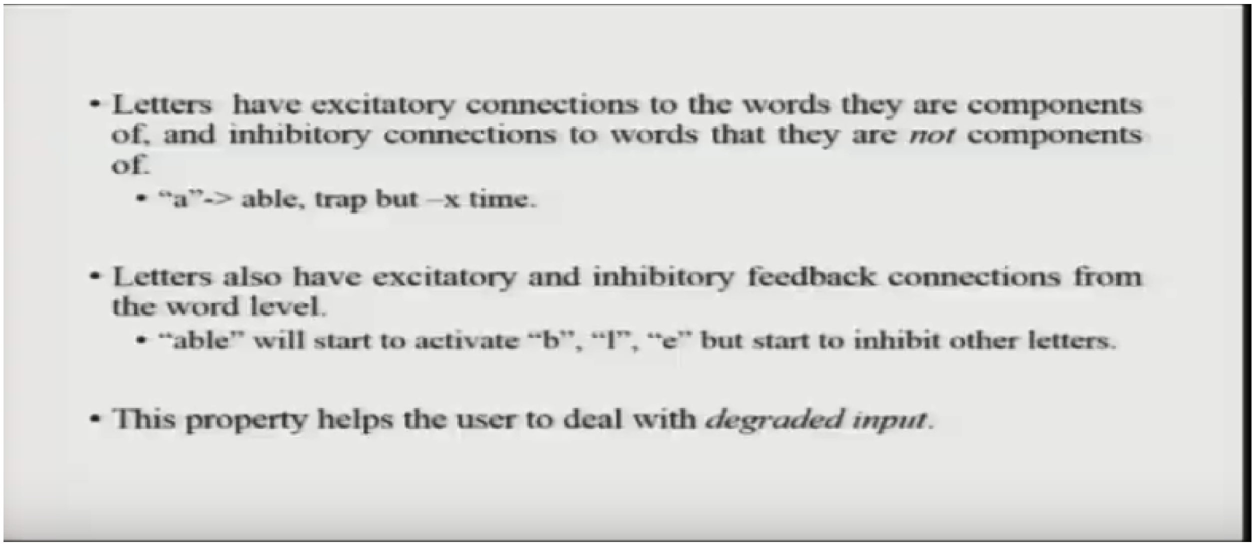

Let us also have excited to be in feedback connection from the word level, so some connection comes down some connection goes up some connections say for example, for the letter a excitatory connection we come from all the words that have A inhibitory connection will come from all the words that don't have a basic Okay? This property kind of helps us,

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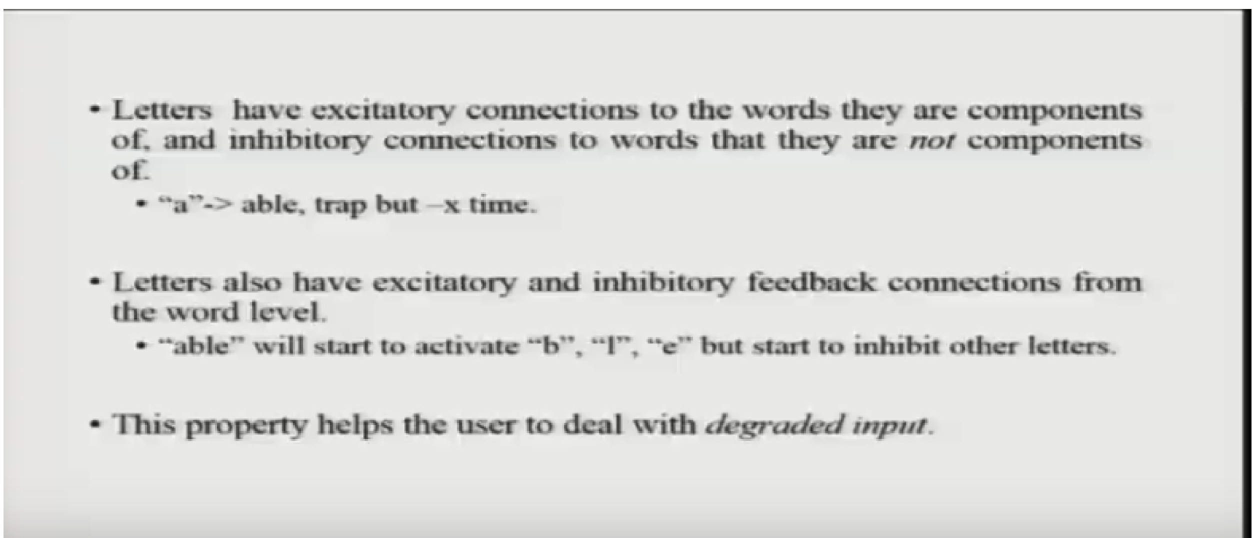

In dealing with what is called degraded input degraded input is what say for example, sometimes if you're reading if you reading from a very old book some of the things have kind of slightly gone off but because you can kind of on the basis of this, you know feedback coming from the letter word level, to the letter level you might be able to build a but sure this might be there but this is the most probable word that there is, Okay? So, in it helps in dealing with degraded input a little bit Okay? Also it, kind of that this whole thing kind of also helps us,

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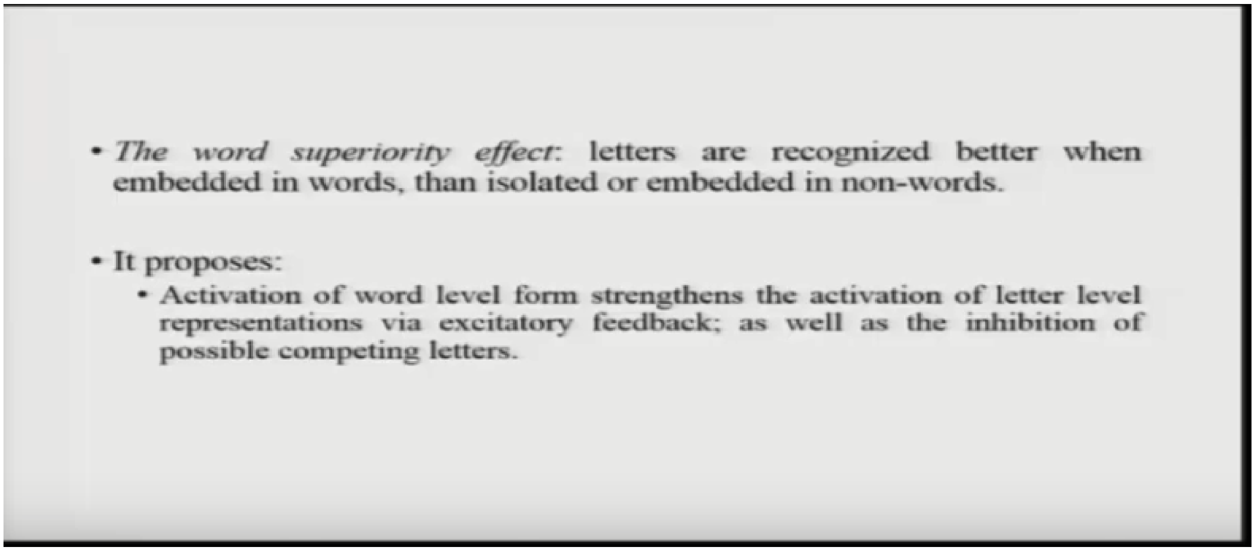

explain what is called the word superiority effect the word superior effect, is very simple is that letters are recognized better if, that embedded in words as composed to in individual sense so suppose say for example, I asked you to remember KGEF or KGXF or KGTF these things of letters or I, ask you to remember say for example, you know something like fem to or you know Sonics or something like so, if I, ask you to remember these exact sequence of letters that are embedded in words you will remember the letters better because what you will store is you not store each of these letters separately but you'll store them as a word. Okay? So, first ever example I, give you a you know string of 12 letters versus I, give you a 12letters word. Suppose I, ask you to you know remember architecture whatever number of words there are, and I give you the same number of letters in a jumbled up fashion you'll find it easier to in you know remember all the letters of the word architecture, because you just remember the word.

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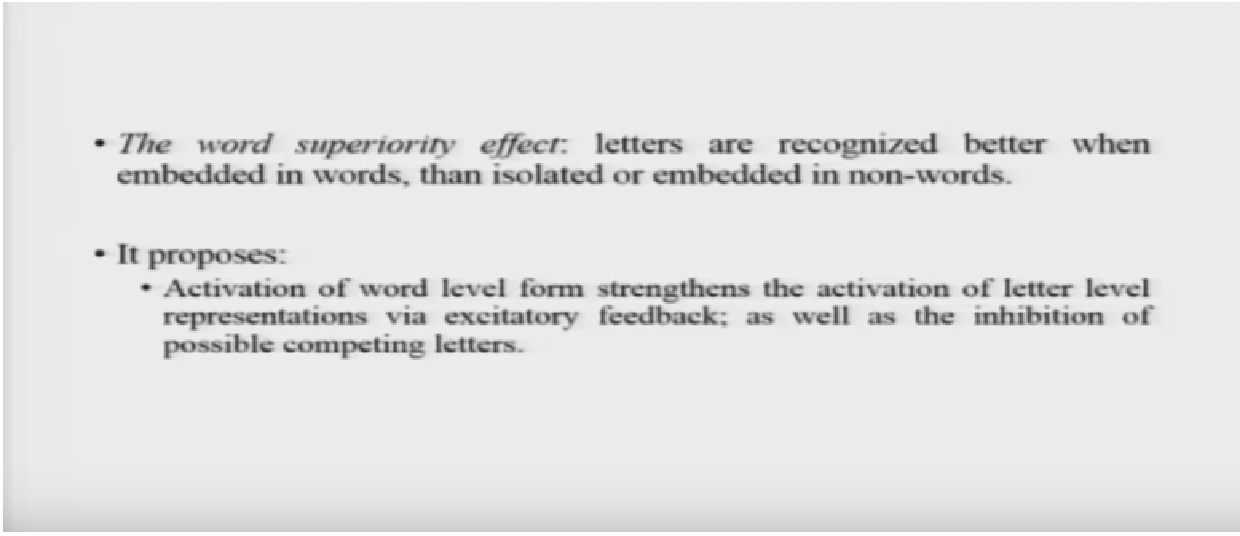

So, the trace model proposes that activation of word level forms renders the activation of letter level representations, by excitatory feedback that is, how you remember this letters better and that's the explanation of the word superior effect.

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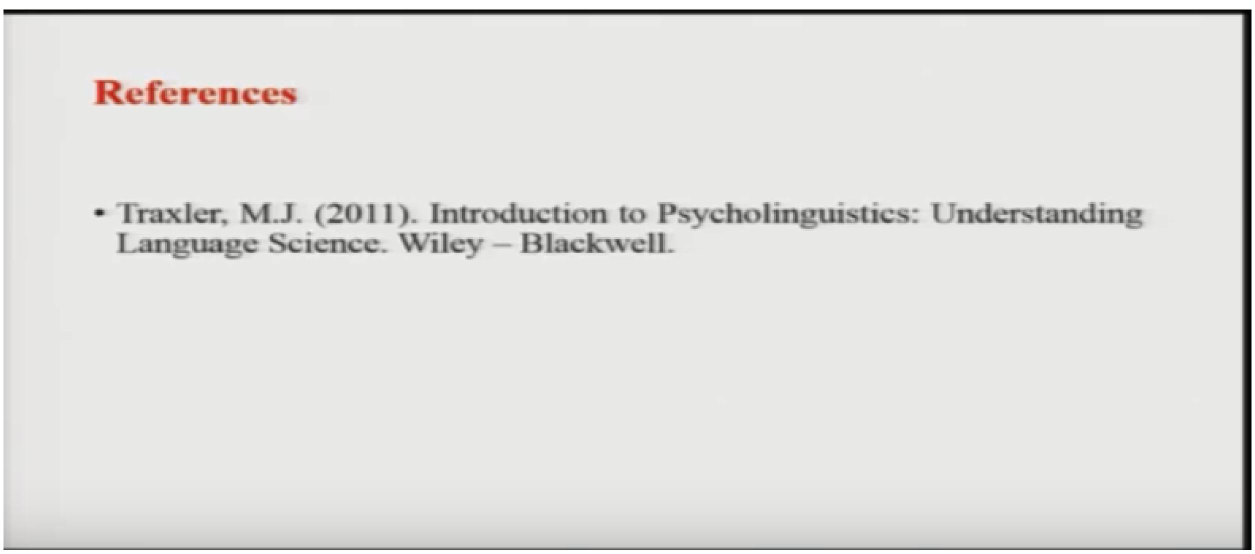

This is all that I had to say in today's lecture we've talked a little bit about how lexical access really happens, we also talked a little bit in this lecture about one of the other kinds of storage of meaning that was the grounded you know or the embodied semantics approach. Thank you.