

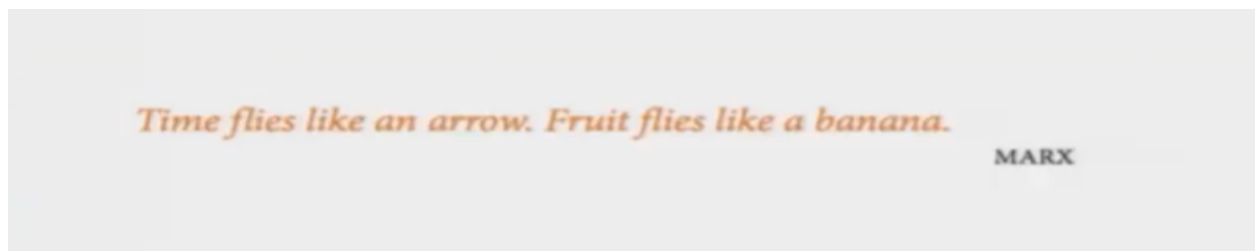
Lecture 21

What is a sentence

Hello and welcome to the course introduction to the psychology of language. I am Dr. Ark Verma from IIT Kanpur and we are in week five of this course. In this week, we will talk about various aspects of

sentence processing. In the last week we discussed about, words the week before that we discussed about speech. Now, once you kind of know what to do with words? Once you know, how a word is understood in terms of its form and in terms of its meaning, what is the next remaining task, for you to accomplish, with as far as language is concerned. With children or with adults, if you're learning a second language that late, one of the things that you start doing, after you know, getting a sense of the words, is to start combining, those words into phrases and sentences. The idea is that you need to be able to you know; combine all those individual strands of meaning, into a whole, which kind of come is capable of communicating a message. Now, these combinations obviously occur, through a number of rules that are, specified in the grammar or the syntax of the language, in sentence processing, we are going to understand, how does the syntax of the language, kind of play a part, in us being able to communicate, very complicated messages and also, further for the listeners or the readers you know, in order to understand, whatever is being said. See, there has to be a bit of consistency, between what I am saying and versus what you are understanding, the underlying rules of language, unless they are the same for both of us, unless the you know, they are consistent for both of us, you will not really, be able to understand what am I saying and I will not be able to communicate, what I intend to. The whole chapter on sentence processing is kind of going to revolve, around those points. In today's lecture we will probably understand about, what are sentences and some of the, intricacies, regarded, regarding processing of sentences and in the lectures Dave and in the lectures after there, we are basically going to talk about, parsing. Now, parsing is basically, one of the ways in you kind of you know, attempts to understand sentence, by understanding its underlying structure and so on. I go on; I talk about passing in more detail in the later lectures. So, let us start today's lecture, let us start the first lecture on sentence processing, by understanding, one of the things, one of the most basic questions, what "exactly" is a sentence. Let us try and take an example and I hope that example, will be able to help you, understanding this.

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Now, there is this quote. I'm not sure whether it is by Marx, himself, but this is an interesting quote, just read this, it says time flies like an arrow. Fruit flies like a banana. Now if you have to understand the second sentence and you're going to use the first sentence, as a cue, obviously you will land in the wrong quarters, time flies like an arrow, is a metaphor it says: that time flies, a and it flies like an arrow would fly that's Alright. However, fruit flies is not the verb, flies basically refers to insects, fly and the idea that is going to be conveyed here is fruit flies, those flies, those insects that, kind of hover around fruits, like a banana. Okay? So, this is something very, interesting and you can kind of you know, if I were to show you, this one after the other, what probably you'll, you know, take a cue off is you'll probably try and read the first sentence as is and because, the first sentence is already, going to establish certain expectations, the reading of the second sentence, might sort of you know, rely a little bit on, how you've read the first

sentence. Also you'll see that there is a sort of a local context here, you would not I mean, as soon as you talk about fruit flies you, you already start understanding. Okay? What is it? However, understanding fruit flies in the first instance, in your first reading of the second sentence, after if you've read the first sentence; can kind of go a little bit wrong. However if I were to present the second sentence to you in isolation, I'm not sure that, a lot of ambiguity, will remain. Now, this is interesting in the sense that these are, pretty much the same words, I've just you know, change a couple of words here and there and it changes the entire meaning, also the same word, can actually you know, play different roles, in different sentences. So, the same word flies, is a verb in one sentence, versus it is, an a noun in the other sentence. So, this is something to kind of demonstrate the intricacies, of processing sentences. Let us move further.

Refer Slide Time :(4: 50)

- **What happened in the example?**
 - Organization of words lead you to understand & mis – understand a sentence.

So, as I said, what happened in the example? Organization of words, could lead us to understand or misunderstand, the given message and this is basically, what sentence processing is about? You have to understand, what are the underlying rules, using which, a particular you know, structure a particular phrase structure or sentence Electra, has been organized. So that is basically what you know we will try and understand. So, how can we define a sentence? A very, simple definition would be:

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- **What is a sentence?**
 - Organisation of meaningful words, acc. to grammatical rules to convey the intended message.

that a sentence could be looked upon, as an organization of meaningful words, according to the grammatical rules of the language. So, if you can take some of the words and so, the meaningful words of the language, obviously more all the words are meaningful you don't really have nonsense or geometrical words. But, if you kind of take all of those words and you combine, them using a particular structure, following a particular set of rules: that is when you will be able to create valid grammatically acceptable sentences. And that is, what will be able to communicate, whatever you intend to communicate, in the best possible manner. So that is, what the definition of a sentence is?

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- Speakers systematically organize those sequences of words into phrases, clauses, and sentences.
- When listeners try to comprehend those sequences, they have to determine how the sequence of words is organized, and use this information to recover the speaker's intended meaning.
- So, when language scientists study sentences, they are interested in how people organize words before and during speaking.
- & they are interested in what cues listeners use to figure out how words in sentences relate to one another, as those cues are vital in enabling listeners to recover the speaker's intended message.

Now, we know that speakers systematically organize the sequences of words, into phrases, clauses and sentences. When listeners try to comprehend those sequences, they have to determine, how the sequences of word is organized and use this information to recover the meaning, from whatever the speaker has said. So, as I was saying earlier, unless the speaker and the listener are on the same page, unless the rules basically of the language are equally, well understood and they are consistent, across situations, it will be very, difficult to achieve successful communication. Further, when language scientists try and study sentences, they are actually interested in, how is this organization coming about, how are people organized in words, into these structures, while they're speaking on the go. So that is, something that is very interesting, to say for example, all this, this one to understand language comprehension, particularly the psycho linguistics and the linguists. So, both of these people, linguists move from the perspective of how a language is particular structured, independent of the user, where a psycho linguist basically are more concerned with say for example, how a particular user, given their own unique profiles, are using a language you know, in, in a more or less uniform sort of a way. Also psycholinguist and linguists are interested in what cues, the listeners use, to figure out how words and sentences relate to one another and these cues, understanding these cues basically becomes vital, enabling listeners to recover the speaker's intended meaning. So, we're talking about, a scenario where say for example, you're saying that whatever structures: that a speaker is uttering, must have some hidden cues, in terms of rules, in terms of okay. This is the agent, to agent must be doing something and should come at the head of the, head of the sentence those kind of things. So, some of these cues basically are need to be picked up by the listener, in order to successfully recover the speaker's intended meaning and these cues are also you know, object of great interest, to both linguists and psycholinguist in order to understand how language comprehension really works.

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- The study of *syntax* involves discovering the cues that languages provide that show how words in sentences relate to one another.
- The study of *syntactic parsing* involves discovering how comprehenders use those cues to determine how words in sentences relate to one another during the process of interpreting a sentence.
- Take an example:

Now, this you know, organization of words into sentences or say for example, the organization of you know, how these cues will be, informative as far as language comprehension is concerned, basically broadly comes under syntax. So, the study of syntax basically, involves discovering these cues: that languages provided, languages provide that show, how words and sentences relate to one another. Also, the other related phenomena is that, of syntactic parsing. Now, syntactic parsing, is I was mentioning earlier, it involves discovering how are those comprehenders or listeners, using the cues to determine, how the words in the sentences uttered by the speaker are organized or related to one another. So, is this an agent and this a patient or this is the agent and that is a patient you know, if it is active voice sentence, passive voice sentence, what is the noun phrase? What is the verb phrase? All of those, things we will see you know, unraveling before us, in a quick bit. But, all of this kind of comes under what is referred to a syntactic parsing, which basically refers to, understanding and thread bearing, a particular sentence and its structure. Let us take an example. Now, there's this sentence, you know, I'm taking, I'm borrowing, so you know, some of these examples, verbitten from Traxxas, book chapters, Indians comprehension. So, so we can kind of stay on the same page as far as these structures are concerned and most of the exam and all of these examples are actually in English. But, yeah! Be with me and understand how, this probably might work. Okay? So, there's the sentence.

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- Dr. Phil discussed sex with Rush Limbaugh.

Dr. Phil discuss sex with “Rush Limbaugh”. Now, this sentence, depending on my reading or suppose if you are reading this you know, you're not listening to, this and reading this, might have one or two meanings. Let us look at them.

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So, What did Dr. Phil do?

Dr. Phil discussed sex with Rush Limbaugh.

or

Dr. Phil discussed sex with Rush Limbaugh.

Now if somebody asks you, what did Dr. Phil do? And you could basically give one of two answers. Dr. Phil discuss sex with “Rush Limbaugh”. So, sex is the topic of discussion. On the other hand, what can be, what is the other interpretation is? Dr. Phil discussed sex with “Rush Limbaugh”. So, basically it could be that you know, the point of discussion was sex with this particular person. Now, both of these, things are basically arriving, from the same organization of sentences and the whole idea, is that you're kind of you know, the sentence is open to multiple interpretations, depending upon, how you organize the words in the sentence. If you see here the way, I've broken this, you'll see that the pause, is taken at different places. So, a sentence one, the pause is taken after the word sex and in the second sentence the pause is taken before the word sex and that kind of changes, the organization and also the understood meaning of the sentence, well you're not sure of what the intended meaning is at this point. But, obviously, for a particular listener, this kind of changes, the entire interpretation. Alright. And this is obviously as said, possible within the same sentence: that is why? It is very important to get these, rules very correct. So that the speaker exactly, gets sorry, the listener exactly gets, what the speaker is intending to say? Now, uh, yeah! So, just kind of looking at it, a bit more closely, one of the likely intended meaning happens, when readers,

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- The two probable instances could be supplemented/or arise out of different contexts.
- For e.g. One of the likely intended meaning happens when readers treat the *prepositional phrase* “with Rush Limbaugh” as being closely related to the verb *discussed*.
- This meaning would fall out of the following hypothetical conversation (Conversation 1):

create the preparation, prepositional phrase with “Rush Limbaugh” has been closely related to the verb discussed, which is the first instance. So, this meaning would fall out of the following hypothetical. So, this basically kind you can, kind of look at, the first sentence, in this kind of a conversation.

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You: Who did Dr. Phil have on his radio show this morning?
Me: He had Rush Limbaugh on the show.
You: What did they talk about?
Me: They talked about sex. Dr. Phil discussed sex with Rush Limbaugh.

So, somebody might be asking, who did Dr. Phil have on his radio show this morning? He had Rush Limbaugh on the say on the show. What did they talk about? They talked about six. Dr. Phil discuss six with Rush Limbaugh. So, this is the first interpretation, whereas with Rush Limbaugh, is basically attached to the word disgust. So, the main you know, the action is basically the act of discussion and that prepositional phrase connects Rush Limbaugh to this, particular you know, sent and this particular verb.

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- In this conversation, the critical thing that the listener needs to do is to package *discussed* and *sex* together, as in *Dr. Phil (discussed sex)* and the listener needs to tie that whole thing to *with Rush Limbaugh*.
- We could paraphrase that meaning as, “Dr. Phil had a discussion with Rush Limbaugh; the discussion was about sex.”

However, in a different conversation, say for example, in a different conversation,

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- The other way to organize the sentence involves treating the prepositional phrase *with Rush Limbaugh* as being closely related to the noun *sex*.
- This other meaning would emerge from a conversation like this one (Conversation 2):

it could be that the sentence involves reading the prepositional phrase Rush Limbaugh has been closely related to the noun sex. And not the verb discussed, then basically the conversation would you know, be something different, say for example, the question would be okay.

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You: Who did Dr. Phil have sex with?

Me: Dr. Phil had sex with Rush Limbaugh.

You: I don't believe you.

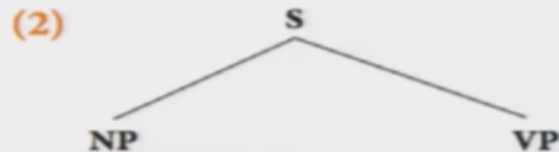
Me: Really. He talked about it afterwards. Dr. Phil discussed sex with Rush Limbaugh. You: !

So, who the doctor will have sex? With and I feel like sex with Rush Limbaugh. You know and you know and then it could kind of move further. So, you could see that, just a little bit of you know, a mistake or say for example, because the sentence is ambiguous, both are acceptable grammatical ways of understanding the sentence, both her and the sentence is perfectly grammatical as it is. So, the idea is this is what one would need to understand, this is what we will need to kind of you know, pay a little bit more attention to is, how do we organize this set? How do we, where do we put this prepositional phrase? Depending upon, where do we attach this prepositional phrase you seeing: that the meaning is changing drastically. So you know, it, it happens you know, so many times that we take, comprehend comprehension or understanding language. So, casually but, this could be, this could serve as a very good example, of that if you do a little bit of a mistake, you kind of could lead to, the meaning to completely somewhere else. So, this is something that, we would you know, want to, you know, look at. Now, this look at something else, we have talked about, phrase structure, at some point say for example, when you're talking about, knowledge of free structure with respect to you know, developmental you know, acquisition of language.

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Ok... let's simplify

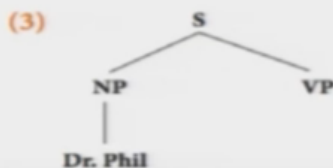
- If one wanted to draw a diagram that depicts the different ways that we could organise the words in *Dr. Phil discussed sex with Rush Limbaugh*, we could use a *phrase structure tree*.
- Phrase structure trees are a handy way of showing how words in a sentence relate to one another.



Now, we kind of revisit that and phrase structure is typically, how do you organize words, into phrases. So, the idea is that, words first are organized into sub, you know, part it is called, 'Phrases' and in phrases kind of can be combined together, into forming sentences. So, a phrase could be a whole sentence in itself, conveying the one single idea or it could basically be combined, with another phrase to create a longer, a more complicated sentence. So that is, what phrases are and one of the ways in order to, understand how phrases really work, is by drawing these, phrase structure trees. So, you can't see an example, right here, if there is a sentence, usually a sentence would comprise of a noun phrase and a verb phrase. Let us take an example, say for example, you can and probably before going through the example, let us try and understand, what the phrase structure tree is about?

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- In a phrase structure tree, the labels like, NP, VP, & S are called *nodes* and the connections between them are called branches.
- The patterns of nodes & branches show how the words in the sentence are grouped together to form phrases and clauses.
- In sentence (1), the leftmost noun phrase will consist of *Dr. Phil* no matter what meaning is assigned, so let's go ahead and add that to our tree below the NP node.



So, you'll see the phase structure tree, there are labels like noun phrase, verb phrase and S, which is a sentence and these basically, these labels are referred to as nodes and the connections between them are

called, 'Branches'. So, you see the lines that join s with NP and s with VP and also then NP with the Dr. Phil all of these are called, 'Branches'. The patterns of nodes and branches, basically shows, how the words in the sentence are grouped together, to form phrases and clauses and it is according to these branches: that we actually, organize our reading of the sentence and our meaning making of the sentence. So, in the sentence first Dr. Phil discuss sex with Rush Limbaugh, the left-most noun phrase would be Dr. Phil and then discuss the sex with Rush Limbaugh can come later. So, you can see the organization could start happening like here's, subject there's a noun phrase, verb phrase, in a noun phrase obviously, who's who are we talking about? The main head noun of this whole thing is Dr. Phil. So, we keep Dr. Phil as the first part of the noun phrase.

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- The meaning that Conversation 1 expresses involves *with Rush Limbaugh* modifying the meaning of *discussed sex*.
- To express that relationship, we need to organize our VP node so that *with Rush Limbaugh* is assigned as a modifier of the verb *discussed*.

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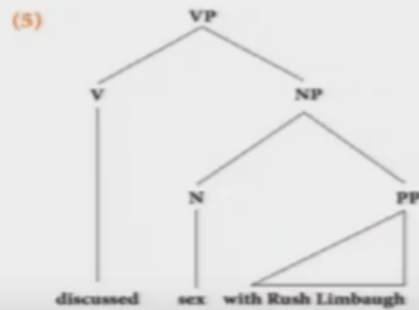
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graph TD
    VP[VP] --- V[V]
    VP --- NP[NP]
    VP --- PP[PP]
    V --- discussed[discussed]
    NP --- sex[sex]
    PP --- withRushLimbaugh[with Rush Limbaugh]
  
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The meaning with that conversation 1, kind of expresses involves discussion of sex with Rush Limbaugh and that, kind of can be expressed through the phrase structure tree: that is depicted right here. So you can see, Dr. Phil was the first noun phrase and then you kind of breaking down the verb phrase, into the main verb is discussed and then you have discussed sex with Rush Limbaugh. So, this is basically, what gives you the meaning out of the first conversation, you see that disgust becomes the main verb and then within that, remaining part, you have a noun phrase and a prepositional phrase. So, verb phrases can also, be kind of broken down into a noun phrase and into a verb and another noun phrase.

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- If we want to get the meaning in Conversation 2, we need to organize the VP differently. i.e. We need to put *with Rush Limbaugh* and *sex* together.



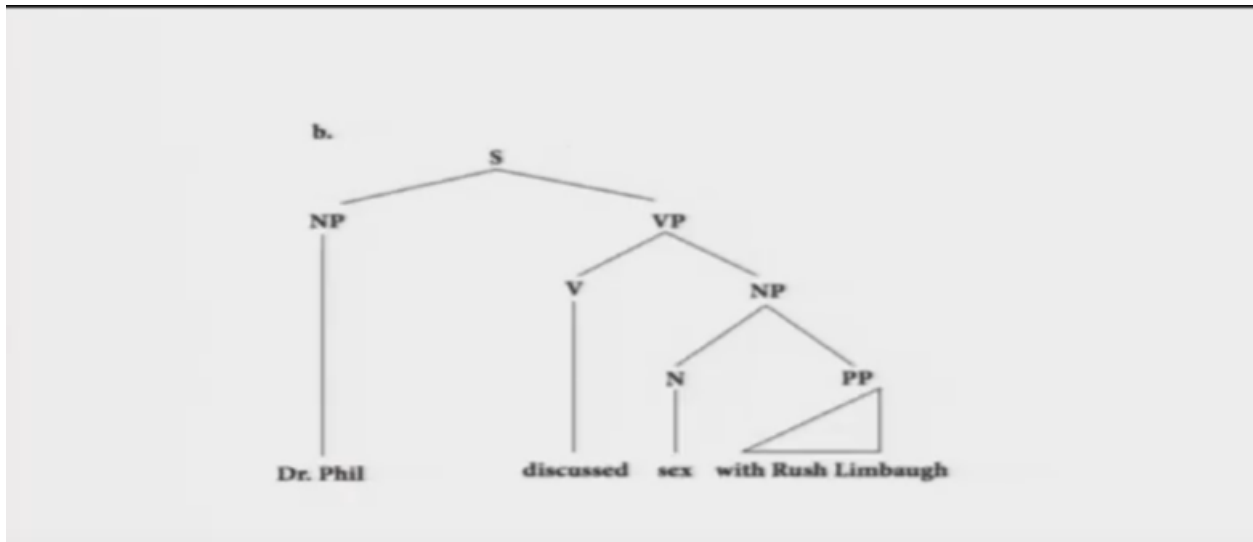
If however you would want to take this to discussion, into the conversation 2, Dr. Phil discuss sex with Rush Limbaugh in, in that conversation you will see that the phrase structure tree, would kind of evolve slightly differently. The noun phrase part will remain the same, but, you need to look at this one and earlier one that I showed, you will see the phrase structure tree becomes slightly different. You see here the, verb phrase can be divided into a verb and a noun phrase where in, noun is the sex and prepositional phrase is kind of attached, with the noun sex. So, you see, discuss sex with Rush Limbaugh. So, this is basically kind of giving a very, different reading and the meaning obviously is completely changed. So, you can see, how to and I am just going back, you see for the organization is different here, the noun is not attached, with the prepositional phrase, there as in the second conversation, the noun is kind of in the same tree, as the prepositional phrase and it's kind of attached to it. And both of these, kind of leads to different meanings.

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Moving ahead, this is how the first conversation would look like. So, Dr. Phil discussed sex with Rush and Dr. Phil discussed sex with Rush Limbaugh this is, the in one sentence.

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And the other one, is actively discussed sex with Rush Limbaugh. So, basically the reading kind of changes you can see the, phrase structure kind of changes and this is what kind of leads as to understand, how the conversation moves. Now, this was just I think, a very basic primer into what we will be talking about, in the coming lectures, basically about how, parsing could work and this was just a very, simple example, of how parsing really might, you know, work. Now we saw, a little bit of an ambiguity here, but, people are generally kind of interested in ambiguity, because they are interested in, understanding where the sentence comprehension or sin this production process might break down.

Refer Slide Time :(18: 23)

Ambiguous Sentences

While Susan was dressing the baby played on the floor.

or

While Susan was dressing herself the baby played on the floor.

So, let's take one more example and this example is, say for example, by Susan was racing the baby, played on the floor or while Susan was dressing herself, the baby played on the floor. These are two

sentences, now if you read the first sentence, while Susan was stressing, the baby played on the floor or you could read it like, while Susan was dressing the baby dash played on the floor so there is a gap there. However if you want to really, disambiguate it, you'll probably insert a word, there and it should start hearing like, while Susan was dressing herself, the baby played on the floor. This is, non ambiguous, this is how you disseminate that particular sentence.

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- Researchers are interested in *globally ambiguous sentences*:
 - Those, that have sequences of words that can be arranged in more than one way, and each of the possible ways are consistent with the grammar of the language.
 - Ambiguity leads to longer reading times, lower comprehension accuracy and different brain patterns.
- Also, *temporarily ambiguous sentences*:
 - Contain a sequence of words that can be configured in more than one way, but overall there is one grammatical way.

Now, researchers basically are interested in these globally ambiguous sentences: Those basically so, the global ambiguous sentences are those that have sequences of words that can be arranged in more than one way and each of the possible way, is grammatically acceptable, grammatically consistent, however each of these different organizations, could lead to different kinds of meanings being formed. So that is, basically, what a globally ambiguous sentences are and usually, what is observed is: that this kind of global ambiguity, leads to longer reading time. So, when readers are going through these, sentences are mostly, when in isolation mostly, the comprehension accuracy kind of comes down, reading time also kind of I'm sure, goes up and brain patterns also kind of show a different kind of activity. On the other hand there could be temporarily, I ambiguous sentences, where is this certain sequence of words: that can be configured, in more than one way, but overall if you look, there's only one grammatically correct way. So, for example, this is not really a lot of you know, because as soon as you start, organizing the sentence into different manners, you realize that okay, only one of them, is grammatically consistent and you will probably go with that, over the other forms. So, this is called a, 'Temporarily Ambiguous sentence' globally Ambiguous sentence, can be organized in many ways, most of all of them are grammatically acceptable, temporarily Ambiguous sentence, can also be organized in many ways, but only one of them is correct. Okay?

Refer Slide Time :(20: 36)

While Susan was dressing the baby played on the floor.

or

While Susan was dressing herself the baby played on the floor.

So, let us look at this, by Susan was dressing the baby plate on the floor, while Susan was dressing herself the baby played on the floor. So, the first one you know, is an example, of globally ambiguous sentence while.

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- People had more difficulty in processing the sentence around the verb *played*.
- Shows that people might be following the two principles.
- *The immediacy principle:*
 - People do as much interpretive work as they can, based on partial information, and making possibly incorrect assumptions, rather than waiting until they have all the information required to make the correct decision.

The second one is an example, of this temporally Ambiguous sentence. Now, people when they were made to read this, they found more difficulty in processing the sentence around a verb played. So, it was people are probably facing problem, as to where does this verb played, get attached to. So, let's look at and why this might be happening is, basically what happens is, one of the guiding principles, you know one of the heuristics that people use in reading, is called the, 'Immediacy Principle'. And the immediacy principle is, people do as much interpretive work, as they can, based on partial information and make possibly incorrect assumptions, rather than waiting until they have all the information. So, what happens is? As people are reading sentences and they're kind of creating structures, they do not wait for the entire sentence to come and then organize the sentence into structures. What people do is they start with you know, say for example Dr. Phil discuss sex with Rush Limbaugh, they'll already okay, this word is comes, this is a noun and then they start attaching words to it. So, they because they don't really wait a lot of times people kind of end up, with correct interpretations, incorrect with, incorrect interpretations and incorrect assumptions, leading to you know, ambiguity in meaning.

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- It indicates that making structural choices, in itself, is not very difficult.
- Also, when people have a choice of different structures, they sometimes, choose the wrong structure.

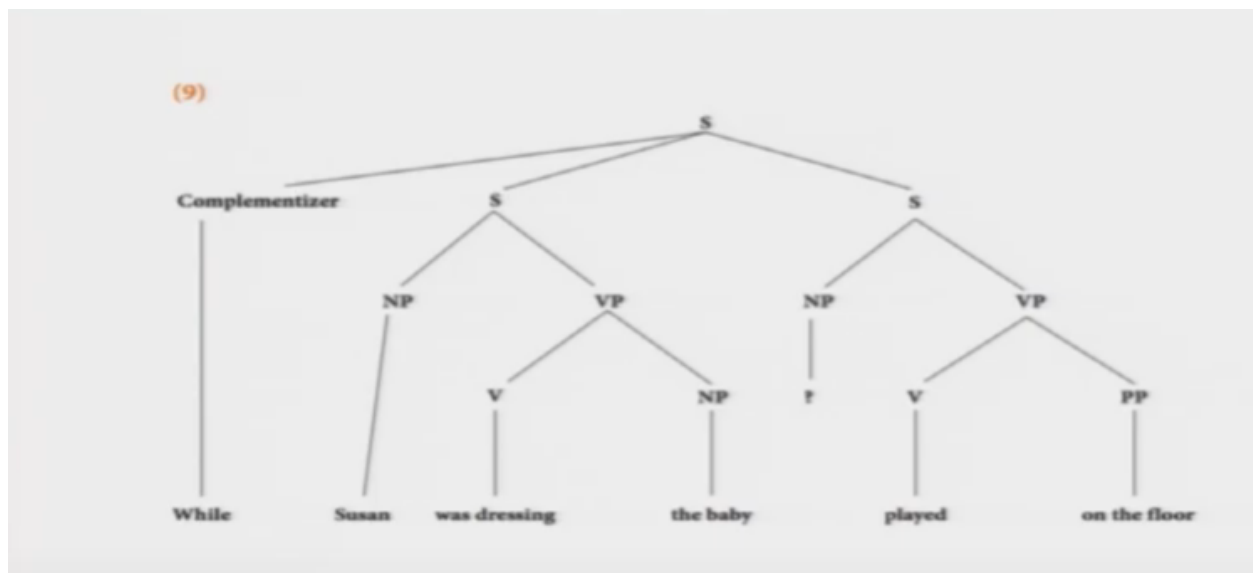
When Susan was dressing the baby ? played on the floor.

or

When Susan was dressing the baby played on the floor.

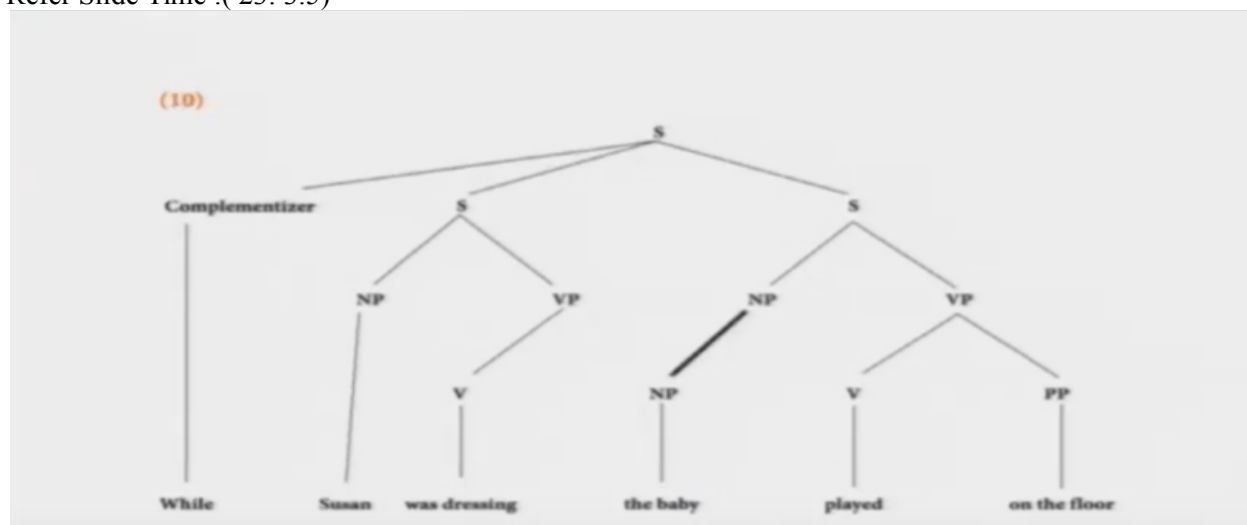
It basically also indicates: that making structural choices, in itself, is not really very difficult. You can be doing this on the fly, what happens is? When people have a lot of these different structures, possible they might sometimes choose, the wrong structure. So, when Susan was dressing, when Susan was dressing the baby, who played on the floor? So, this can lead to a you know, ambiguity and wrong structure, while say for example, if you put it like this, when Susan was dressing, the baby played on the floor. So, this second kind of structure is, more easily understandable. So, if the person would have kind of waited and not attached the baby to dressing already, then played on the floor, played could be attached to the baby and thing, could have been more easier to understand. Okay? So, following the immediacy principle, people usually don't really, way till the end and while, when Susan was dressing the baby came and they attached the baby to dressing: that could kind of lead to that, this kind of ambiguity that we saw here. Now, just look at the sentence structure, free structure of these two sentences, you have Y which is a complementizer it doesn't really, play a very important role here.

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But, you see, while Susan was dressing the baby is one sentence. And dash played on the floor. So, now you have this dash, which is an anomaly you don't know, what is playing on the floor? This is the incorrect assumption, why has this resulted because, you've attached the baby, to Susan was dressing. So, the idea is you kind of thinking, the Susan was dressing the baby and then you don't know, who is playing on the floor? That is kind of you know, leading to this anomaly.

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However if you reorganize the sentence what you would do is? You while say keep Y there, while Susan was dressing, in one sentence and the baby played on the floor in another sentence. So, you know, who is playing on the floor and Susan was dressing is kind of alright and it is kind of understandable: that Susan probably was dressing herself. Okay? So that, kind of you know, can lead to multiple interpretations.

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Take home message...

- It takes a great deal of processing for a sentence to start making the "right" sense for us.

Now, this is just a very brief, very superficial exercise on understanding, what is going to come next in this chapter? We're going to deal in, deal with more and more of these structures, basically trying to understand, how is it that people are organizing these, are they following some foundational principles. What kind of foundational principles are they following? And we will see, you on the fly that you know, what different kinds of structures, can result, with different kinds of principles, how do we understand what rules to apply where? Do we actually, need those rules, do we actually process and pass these rules. This is basically what we are going to cover, in the rest of the week. So, the take home message for today,

is that yes, it takes a great deal of processing for a sentence, to actually start making sense and if you commit a mistake here and there, obviously the sentence can make, you know, very different meanings and you the speaker might not be able to convey, the intended meaning in the first place. Thank you.