The Psychology of Language
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Lecture No. – 17
Reading and Writing - II

Hello friends, welcome back to this lecture number 17 in the course on the psychology of language. Now, what we have been doing the last lecture is we have been looking at the cognitive processes which is involved in reading and writing. Now, I have told you previously that reading and writing is something which is not natural for human beings, the reason being that there are no brain systems or there are no brain areas which are dedicated for either reading or writing.

And, as you can understand, both reading and writing have evolved in the last few centuries only. It is a new development and it only evolved when human beings settled and formed agrarian societies. So, these systems, the systems of reading and writing are a newly developed system. And, so, what these systems actually do is they make use of those brain areas and processes which are dedicated to some other functions, some other cognitive processes.

So, before continuing this lecture and talking more about reading and writing and reviewing what we did in reading and writing in the last class, let us take a small journey back to the very start of this course so that we have some context on where the course is. So, we started out by looking at what is language for that matter, and then, how language is different from communication.

We looked at what is the need of a language and for understanding language we started looking at the very basic communication system. So, the first step that we took was distinguishing between what is language and communication. Once you had established that, we looked at the most primitive form of communication which is the animal communication system.

So, we looked at what is animal communication system, and once we had an idea of what an animal communication system is we looked at examples of that kind of a system. Some of

these examples being the waggle dance of the honeybee, call of the vervet monkeys, and other basic systems of information transfer or transfer of certain ideas between animals. We looked at characteristics of those kind of a language.

And from there we developed on to understanding the human language system. We looked at how the pyramid of the human language system exists and what are the various functions of different steps in this pyramid. So, what is the role of the different steps? We looked at the idea of phones, we looked at how these phones combined together to form something called morphemes which are not exactly words but some form for word which has some meaning.

And then, we looked at how these morphemes combined together to form something called words, and these words combining again using certain syntactic rules, certain grammatical rules to form sentences, and how the sentences then form a discourse. Now, discourse is when people talk. So, we looked at these kind of things. Once we had an idea of how human language system is, some idea of the human language system, the characteristics of the human language system, we moved on to two other processes.

One being looking at the evolution of the language system, the human language system, and the other being looking at certain evidences for it. So, we started out by looking at how the human language system developed from our great great great grandfathers and we looked at specific evidence, for example, the idea of recursion in language, particularly in the English language.

We looked at the idea of how a specific **(()) (4:21)** gene was held responsible for language development. We looked at the continuity and discontinuity theories of language, and further to that, we also looked at evidences as far as the use of pidgin and the proto languages and development of the auditory certain, the vocal tract, how these suggest that language developed from the ancient humans which was there.

So, language had some other form in ancient humans and it developed over the years. So, once we had a brief idea or a brief history of what language was all about, the other obvious fact was to look at how the science of language really works. We dedicated ourselves lecture three and four into understanding the science of languages. e started out by looking at what is

a scientific method in language studies and how experimental designs are used, what are variables and those kinds of things, so exactly how the research is done in language studies.

We look at researches in language studies from two basic parameters or two basic methodologies; one being the behavioral technique where we focus mostly into something called a latency which is the reaction time and accuracy. From the electrophysiological point of view or the brain system point of view, we looked at regions of the brain which is responsible producing languages, and those kind of equipment, those kind of pathologies that we use for measuring brain responses which are responsible for producing language.

That is what we did in the second section. Now, having had an idea of what language is all about, a little bit of history of language and looking at a little bit of evidences for supporting those histories, also understanding how research in language is done and what are the various intricacies in language studies. Now, we dwell into understanding spoken language because the idea of language that we are doing here is we will start with spoken language and then go to written languages.

So, we started looking at how spoken language is perceived and produced. So, these were the next two sections which is the section on lecture number five, six, seven, eight, if I remember it correctly. Especially in the lectures on language perception, we looked at how sound is perceived. Language basically is composed of the written words or spoken words, and so business we were looking at spoken words, we looked at how languages perceive.

We were interested in looking at those factors which help in the perception of language. We were specifically interested in understanding auditory perception because language, mostly spoken language, follows the rules of auditory perception. So, we looked at those rules, we looked at those parameters of auditory perception, for example, what is overtone, what is general frequency, what is base frequency and those kind of things.

We focused on how the human ear is built up and how it picks up sound and how it modulates sound or how does it deal with sound waves which enter the ears. So, we are now looking at sound perception, how do we perceive sound. We looked at speech stream, for example, if something is spoken to you, what does it consist of is what we looked at. We looked at those pressures of words which are spoken to you, whether they are continuous or

discontinuous, and what kind of forms it can take, and how are consonant and a vowel represented in the speech stream.

So, we looked at the speech stream through a spectrograph and the various basic principles of the speech stream, or what is it consist of, what is the competition of a speech stream. Then we looked at the theory for development of speech perception. We looked at how speech perception happens in children. We looked at several ideas and several models in there. And finally, we looked at several theories of speech perception where we focused mainly on three theories.

We focused on the idea of motor theory which basically suggests that perception of motor movements in addition to perception of sound waves actually help us to perceive language. We looked at the general auditory framework which says that nothing like the motor theory happens, and we looked at the idea of direct realism also as a theory of speech perception. Now, once we had some idea of how speeches proceed, our next interest was looking at how speech is produced, because if it is produced, only then it could be perceived.

And so, we look at those apparatus in the human system which produced speech, detailed analysis of what the vocal cord is and how the production of speech happens. We then dedicated ourselves into understanding the speech areas in the brain, various speech areas of the brain, how they interact particularly focusing ourselves into the Broca and Wernicke area. Of course, these are the same areas which are used for producing speech and also perception of speech.

So, area by area we looked at Brodmann area for speech production and speech perception, and focusing on to the Broca and the Wernicke area, and also some areas on the temporal cortex and the frontal prefrontal cortex, for example, the insula which is used for producing speech. We looked at several models of speech production, for example, we looked at the feedforward and feedback model, we looked at the DIVA model which is a computational model of speech production and several other models, which tell us how speech is produced.

And lastly, we looked at development of speech productions, how does speech production actually develop? We looked at those principles, we looked at those variables, we looked at the nature of speech production in children. So, once we had an idea of how speech is

produced and how speech is perceived, the next step was obviously focusing on the idea of what does this speech composed of first of all, what is the basic unit of speech and how does this speech relate to some idea.

And for that, we needed to study concept, an abstract concept of what is called a word. Now, word is basically a combination of two or three things. It has a pronunciation which is basically the speech part of it, and it also has a meaning which is the symbol that it represents. So, we started looking at what is word and how does word represent an idea in terms of symbolism and a speech sound in terms of perception.

So, we started looking at what is word and we started looking at what is the anatomy of a word, how many different kinds of words can exist. We basically enlightened two different kinds of words, the functional word and the content word. We dedicated ourselves to that and we also looked at how word established itself as concepts or they are labeled as concepts, and again focused on the phonology of the word and semantic meaning of a word.

Once we had done that, we started looking at how words are learnt. So, how do children learn words? So, we looked at the various curves which exist, the S-curve, or the idea of how neighborhood density or different words help children learn words. So, that is what we were interested in. We were looking at how people develop this word lexicon or the idea of how words are processed by humans.

So, how do humans learn words or children learn words for that matter, if not adults, because adults have already learned a number of words. So, what are the various factors and variables and methodologies through which children learn words. And the next that we were interested in was, once a word is learnt where it is saved. So, we were looking at the idea of the mental lexicon and the cortical lexicon which basically suggests that words are stored as something called networks and these are these has same properties as the semantic memory.

So, here, what I will do is I will refer you back to my lecture on cognitive psychology where we discussed what is semantic memory. So, we started looking at that and had an idea of how words are stored into the mental lexicon in terms of semantic information. And, the last idea that we did was, we looked at how these words are retrieved. So, what is the process of retrieval of this word from the mental lexicon.

And there we were interested in looking at recognition of words, and several other models which explain word recognition and word retrieval, the one being the **(()) (13:28)** model and the other being the Dell interactive model which explains how words are retrieved from memory. Now, once he had an idea of what a word is, the next obvious thing was words combining into sentences.

Why single words have no meaning? And so, the other idea was to understand what is sentence, and so we looked at what sentences are, how words are grouped together to form sentences. So, what is the structure of a sentence and what is the syntactive, how does the children learn to comprehend sentences? Now, sentences have a number of words and the same words may function as a content word or a function words.

So, how do children understand comprehension of a sentence was the next thing that we focused on? We looked at how children produce sentences or people produce advances, what are the factors responsible for it, and how sentence production, what are the factors which actually help in production of a sentence. And the last thing that we were concerned is how syntactic structures or syntactic rules for producing sentences are learnt.

That is what we were focusing on, the idea of what are sentences or what sentence structuring is. Now, once we have sentences, we need to converse and that is the idea of discourse we jumped in. So, we looked at what is discourse, how discourse really work. So, discourse is people talking? There are two forms of discourse, we have the conversation and we have the narratives.

In conversation many people speak and they take their turns in speaking, and in terms of narrative, one person speaks and the other listens. So, we started off by first understanding what is a conversation, what is turn taking, how do people understand their turn in conversation, how do they talk and how exchange of idea is happening in conversation, and other basic factors influencing conversation.

The next thing that we were interested in is understanding what a narrative is and how does this narrative lead to references. We looked at what are story grammars, basically it is a form of narrative, and so most stories actually use something called story grammars. We looked at

the idea of referencing in narratives and how these referencing actually helps us in forming a good narrative or forming a better narrative.

The next thing that we were interested in is understanding the idea of anaphora which is a replacement word for most contained words. And, so, you can think of anaphora as a pronoun and in some other times it is used as replacement word. And, so, what anaphora does is it actually helps us in comprehending a because. So, we looked at the principles of using anaphora and how this anaphora is used in sentences and how it helps us in inferring meaning from sentences in discourse.

The last thing that we learn is how the abilities for learning discourse is developing both adults and children and how looking at specific problems in discourse learning they point out the various factors of discourse learning. The next thing that we were doing in the last class was looking at reading and writing. Now, as I said, reading and writing is something that is not natural, it is something that we developed over a period of time.

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And so, the first thing that we looked at is what are the different forms of writing systems in the world. We looked at three different writing systems; one is the logographic form, the other the syllabary form, and the third one was the alphabet form.

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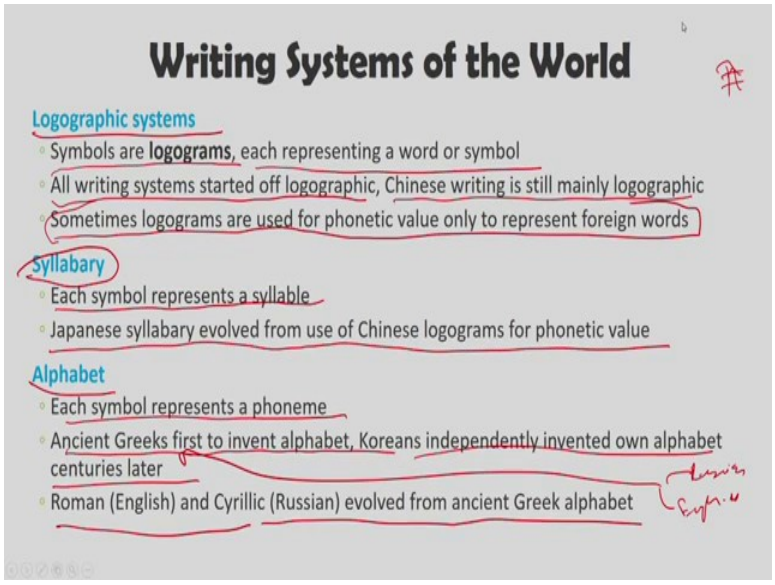

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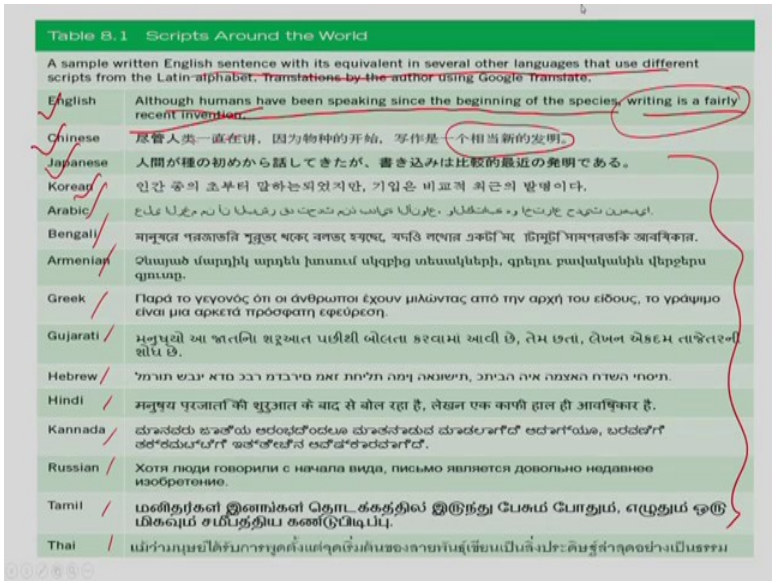

Table 8.1 Scripts Around the World

A sample written English sentence with its equivalent in several other languages that use different scripts from the Latin alphabet. Translations by the author using Google Translate.

English	Although humans have been speaking since the beginning of the species, writing is a fairly recent invention.
Chinese	尽管人类一直在讲，因为物种的开始，写作是一个相当新的发明。
Japanese	人間が種の初めから話してきたが、書き込みは比較的最近の発明である。
Korean	인간 종의 초부터 말하는되었지만, 기입은 비교적 최근의 발명이다.
Arabic	على الرغم من أن البشر قد تحدثت منذ بداية الأنواع، فالكتابة هو اختراع حديث نسبيا.
Bengali	মানুষের পরজাতির শুরুতে থকে বলছে হয়ছে, যদিও লখোর একটি মে টিমুটি সাম্পরতকি আবষ্কিার.
Armenian	Չնայած մարդիկ արդեն խոսում սկզբից տեսակների, գրելու բավականին վերջերս գյուտը.
Greek	Παρά το γεγονός ότι οι άνθρωποι έχουν μιλώντας από την αρχή του είδους, το γράψιμο είναι μια αρκετά πρόσφατη εφεύρεση.
Gujarati	મનુષ્યો આ જાતિનિ શરૂઆત પછીથી બોલતા કરવામાં આવી છે, તેમ છતાં, લેખન એકદમ તાજેતરની શોધ છે.
Hebrew	למרות שבני האדם דברו מרגע תחילת המין האנושי, הכתיבה היא המצאה יחסית.
Hindi	मनुष्य प्रजाति की शुरुआत के बाद से बोल रहा है, लेखन एक काफी हाल ही आविष्कार है.
Kannada	ಮಾನವರು ಜಾತಿಯ ಆರಂಭದಿಂದಲೂ ಮಾತನಾಡುವ ಮಾಡಲಾಗಿದೆ ಆದಾಗ್ಯೂ, ಬರವಣಿಗೆ ತಕ್ಕಮಟ್ಟಿಗೆ ಇತ್ತೀಚಿನ ಆವಿಷ್ಕಾರವಾಗಿದೆ.
Russian	Хотя люди говорили с начала вида, письмо является довольно недавнее изобретение.
Tamil	மனிதர்கள் இனங்கள் தொடக்கத்தில் இருந்து பேசும் போதும், எழுதும் ஒரு மிகவும் சமீபத்திய கண்டுபிடிப்பு.
Thai	แม้ว่ามนุษย์ได้รับการพูดตั้งแต่จุดเริ่มต้นของสายพันธุ์เขียนเป็นสิ่งประดิษฐ์ล่าสุดอย่างเป็นธรรม

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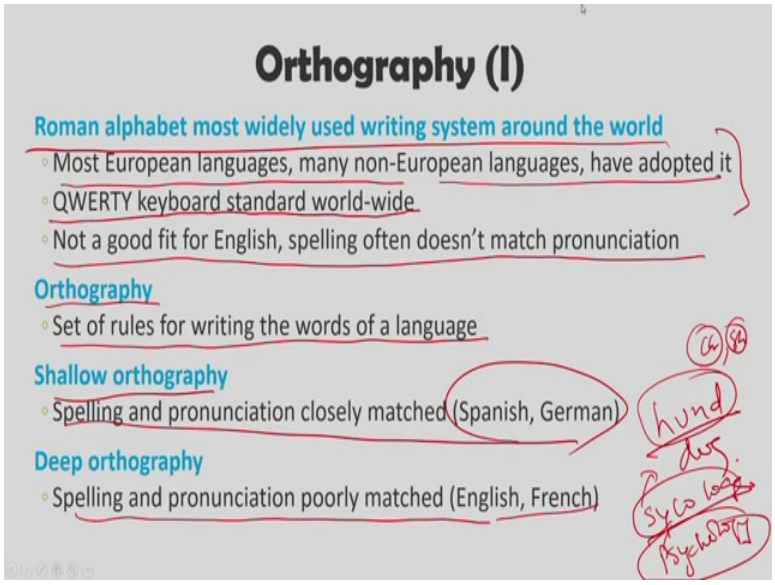

We also looked at what writing systems are all about and then we looked at something called orthography which is a set of writing the words of language. So, we were focusing on these kinds of orthographic changes are these kinds of rules that are used. And what we understood from there is there are two types of orthographies; one is the shallow orthography in which the pronunciation and the word that is meant, that is spelled, it means the same.

In the other one, the pronunciation and the spelling are different. So, some languages have deeper orthography, for example, English as deeper orthography. On the other hand, German and Korean have shallow orthography. So, we looked at how this autography really works.

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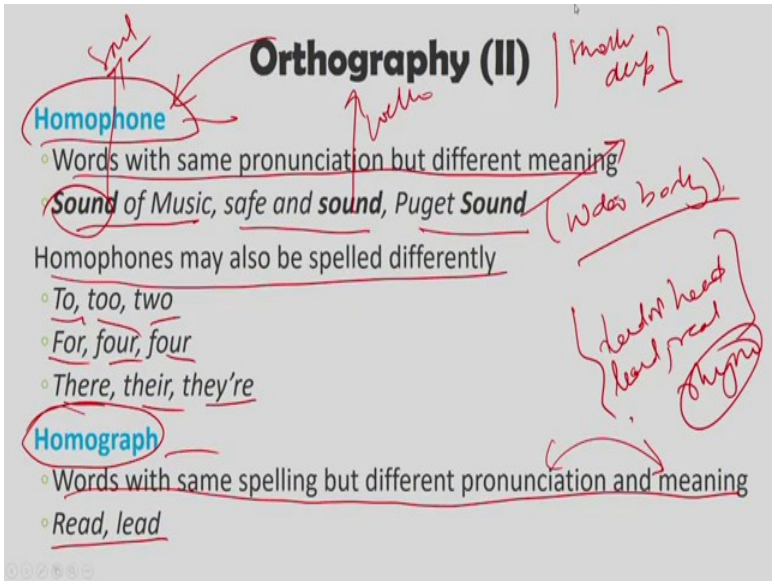

We also looked at distinguishing between shallow and deep orthography in terms of using the homophone and the homograph.

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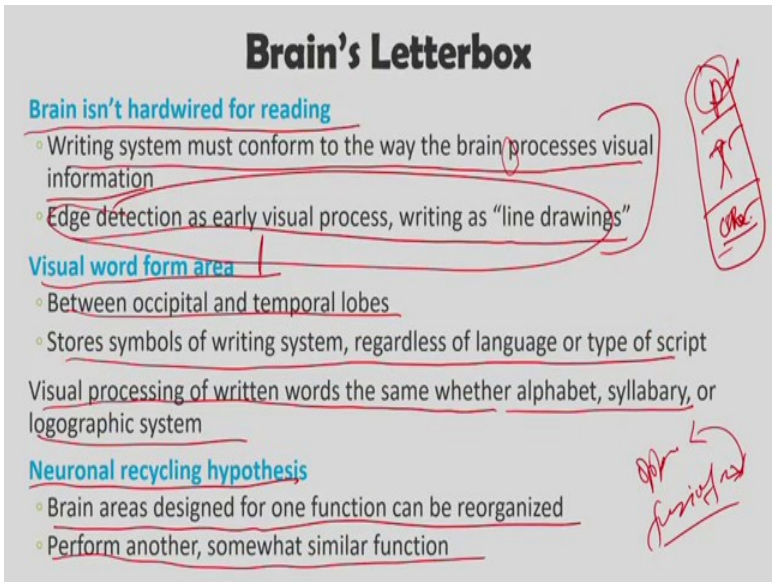

We looked at how the brain processes and brain systems are piggybacked on to help us reading and writing. So, we looked at how the visual form area they perceive the symbols that we write to form words. And, from there, how does it extract meaning and the idea of neuronal recycling hypothesis?

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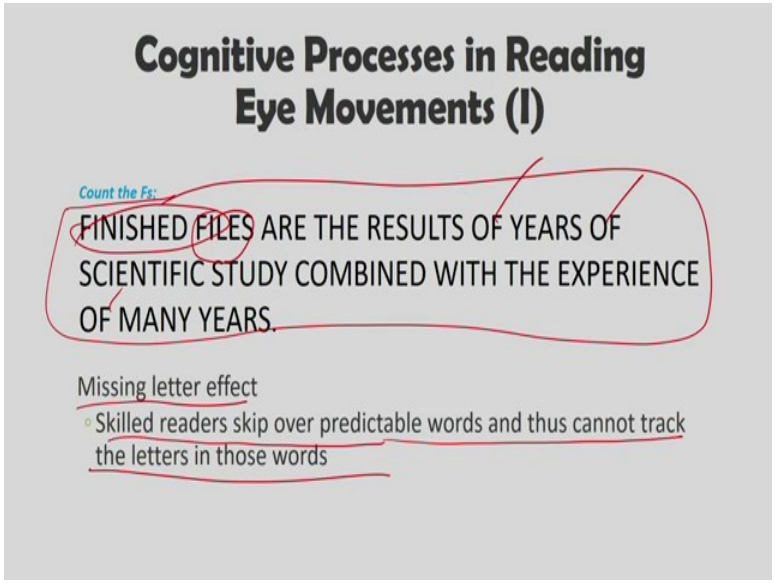

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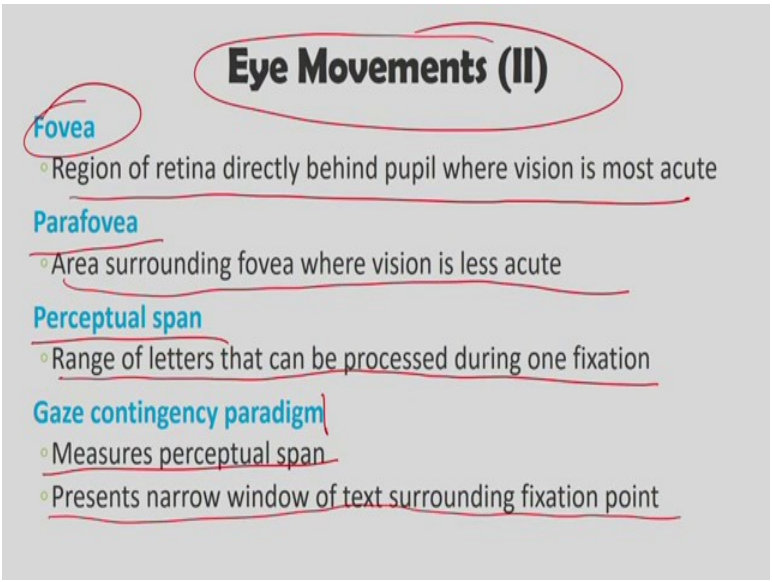

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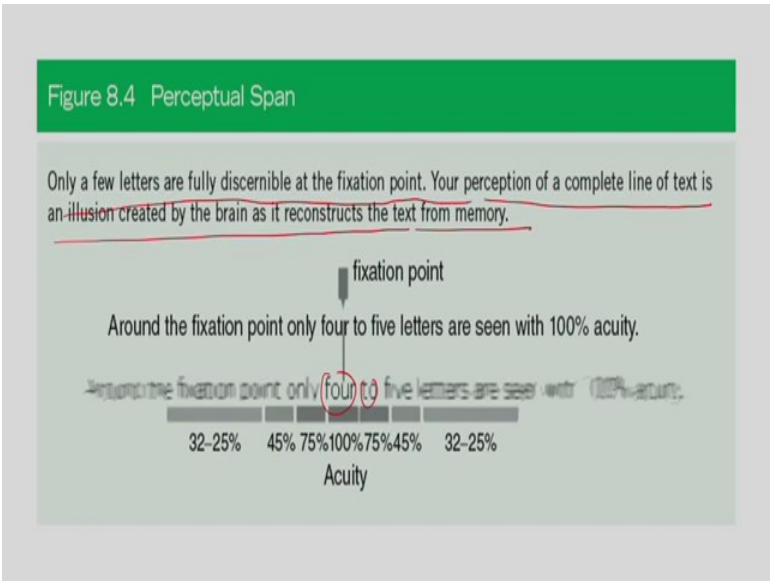

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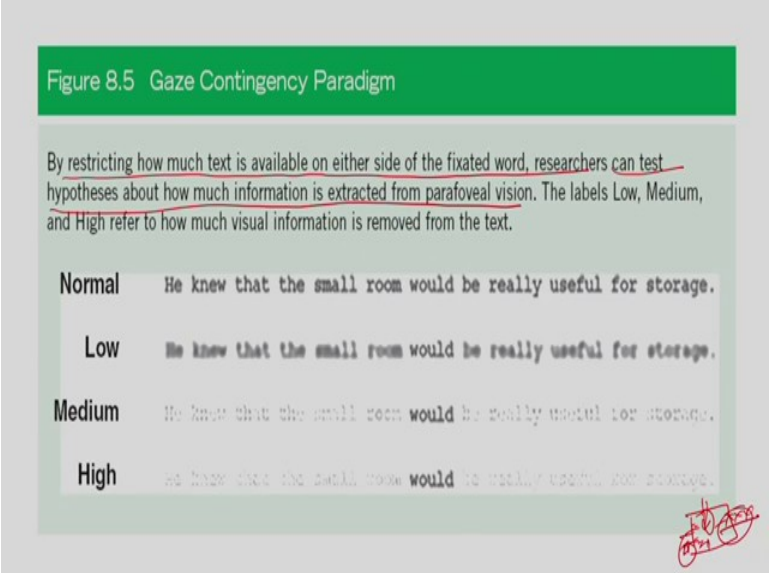

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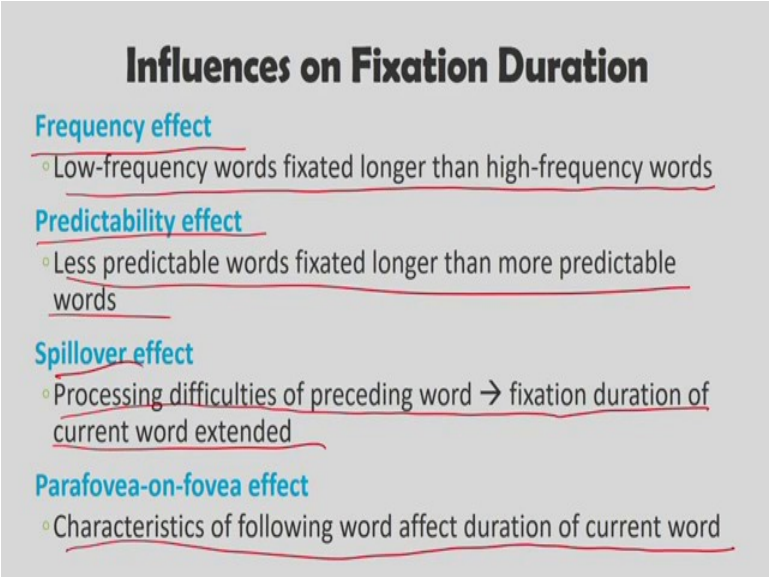

We looked at cognitive processes in reading which is how the missing letter effect and the idea of eye moments and perceptual span actually helps us in reading.

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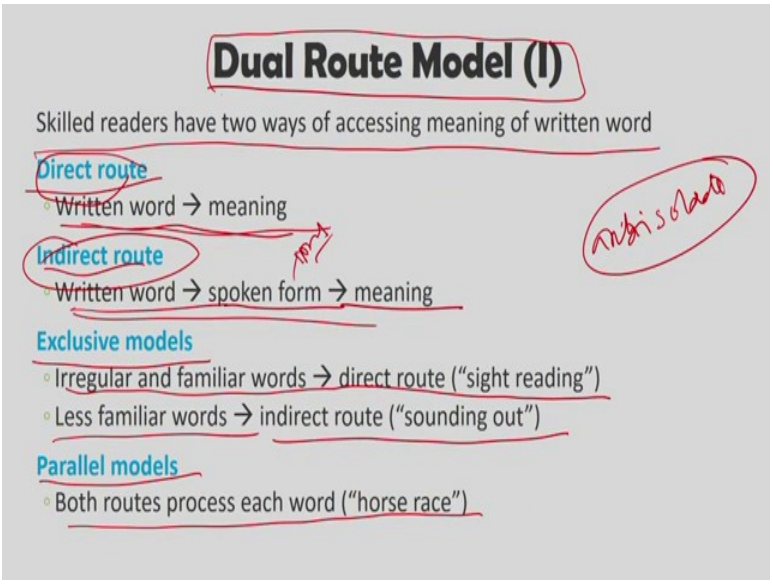

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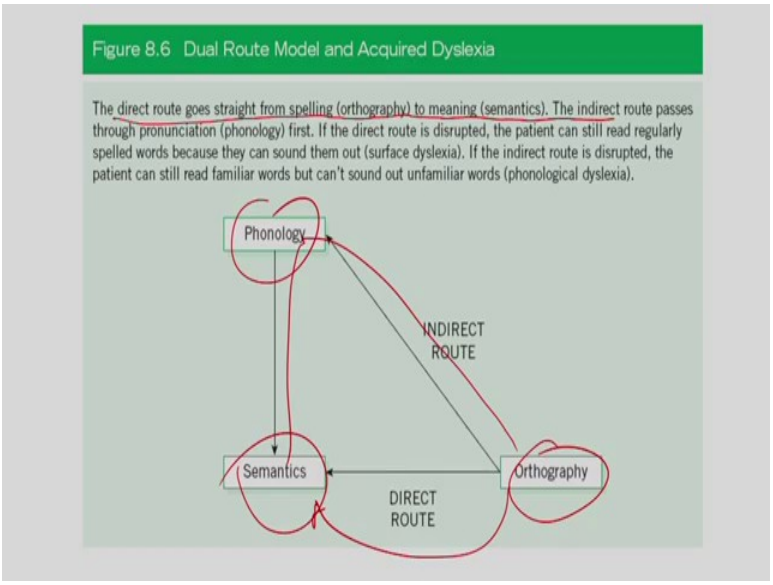

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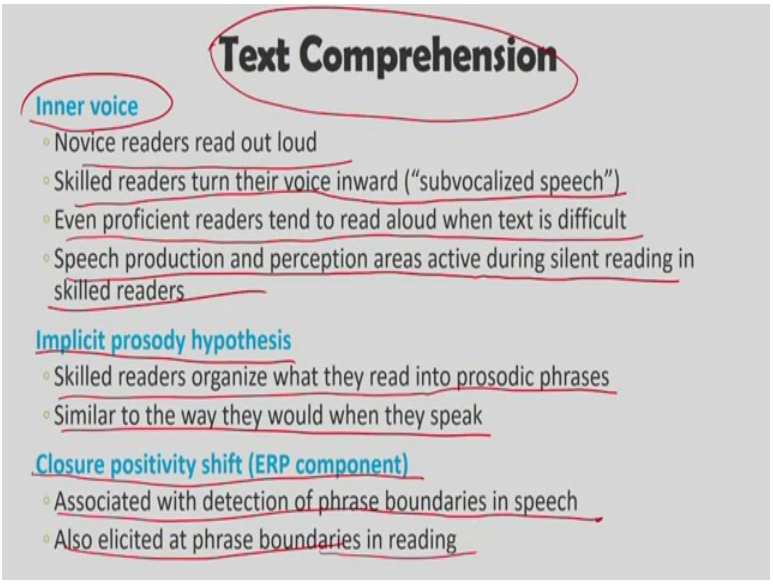

We also looked at the idea of fixation duration as a predictor of reading ability and the dual route model, of course, which explains how does reading happens. The last thing that we were doing was we were looking at text comprehension and how does text confirmation happen, and how does implicit personality hypothesis or inner voice system explains us how do we comprehend text.

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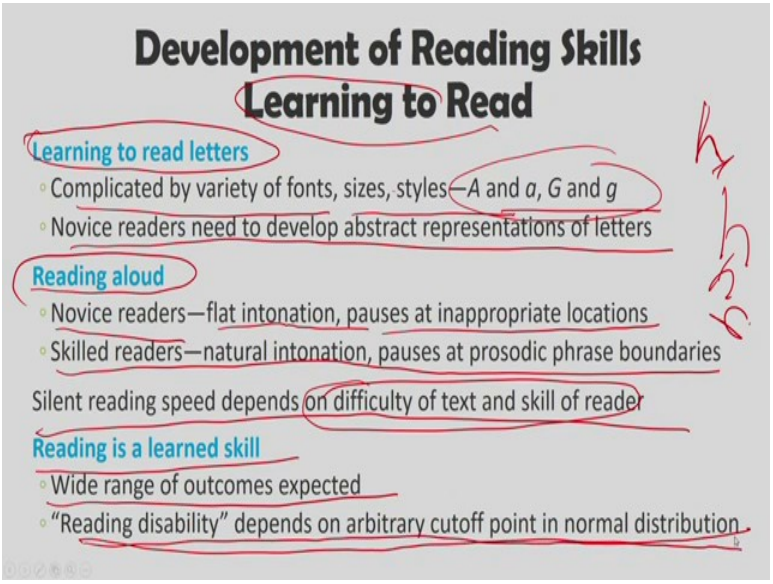

In today's class we will focus on to the development of reading skills and how do children and adults learn to read. Now, development of reading is something which is very difficult because most people do not ever read anything. So, learning to read is in itself a difficult job. Now, one of the things that make reading difficult is the fact that learning to read is complicated by a variety of font styles and sizes and so on and so forth.

So, when we read it could be handwritten text, it could be text which is written on some form of a pamphlet, on a paper, on some other formats. And so, reading gets difficult by the type of font that we use, by the type of sizes of the letters that we using, the words that we are using, the style that we are using, and so on and so forth. Just look at these A and a, G and g, and that will give you an idea of how reading can be difficult.

So, the first obvious step in any reading scale is learning the letters of writing the particular system. Now, it is complicated by these facts. So, novice readers they need to develop abstract representation of the letters.

So, the first step that any novice reader has to do in terms of reading is to develop these abstract representation of letters. So, how do we do that, there is a certain region of the brain which helps the readers to make abstract configurations or to make abstract concepts of what a letter would actually mean or what a symbol would actually mean. And that actually helps us in understanding symbols and reading.

Now, this process of abstracting that this particular brain area does, the occipital area of the brain does, is called prototyping. So, what the brain does is it starts understanding handwriting. Now, novice readers mainly use, most novice readers they develop a set of abstract presentations for each letter for visual word form more generally, so they learn to recognise regardless of the font, case, or style.

And how does it happen? What happens is, since they look at a number of presentations of these letters, they quickly develop a prototype out of it and prototype is the best example or the minimalistic example of any number of object variations that can exist. And so, there is a prototype, for example, a prototype of a car is having an engine and four doors, and cover onto it. This is the basic prototype.

And in that, if you keep on adding things, you can get a sports car, you can get a sedan or whatever and what not. Similarly, the way H can be written in different styles, the basic idea of writing an H is having these two things. And so, developing a prototype requires us to have these two things, and so, a letter like this and a letter like this. So, I can write an H like this, and so this is how the development of prototype is, and helps the novice readers to understand the various styles and less complicate the idea of reading.

Now, another thing that helps readers in learning to read is reading aloud. Novice readers they read with flat intonation, pauses at appropriate places and locations, and this helps them in actually reading. Novice readers mainly use an indirect route accessing pronunciations before meaning, but they gradually shift to greater reliance on a direct route. So, initially what novice readers actually do is they pronounce the word and from there they start to extract meaning of the word.

As they keep on doing that, as they become skilled leaders, they use a more direct method of reading and learning to read and what they then do is they access meaning before pronunciation as reading skill. Now, this shift can be observed in neuroimaging studies which show more activated in the dorsal stream of early readers, but more activity in the ventral stream of the skilled readers.

And so, if you can see, the neuroimaging studies produce what they say is that ventral stream is about meaning and dorsal stream is about pronunciation. We have done this or we have made this clear right from the section on words. So, what happens is normal readers they read aloud and this read aloud helps them in understanding the pronunciation of the words and this pronunciation of the words actually help them in understanding the meaning.

But as they develop over a period of time, they start accessing the meaning and from there they go back to the pronunciation. So, skilled readers they have natural intonation, pauses at prosodic phrase boundaries. Silent reading skills depend on difficulty of text and skill of the readers. It is not that skilled readers do not actually read with an inner voice as we explained in text comprehension.

What happens is for easy text they do not do this inner reading or with the inner voice, but as the text gets difficult the skilled readers also start doing something called silent reading. So how reading is developed, the skill of reading is developed? Now, the thing is that there is a wide range of outcomes which can be expected and reading disability, they depend on the arbitrary cutoff point in normal distribution.

What really happens is that unskilled readers they often read aloud with flat intonation and pauses in appropriate locations, while skilled readers learn to read with natural inclinations

and pausing for prosodic phrase boundaries. What happens out of this is that this happens because of this particular fact that natural readers use something called naturalistic way of reading and unskilled readers follow flat intonation.

This is in line with something called the implicit-prosody hypothesis, if you remember from the last lecture, which proposes that prosody guides the comprehension even in silent reading by breaking the text into short meaningful phrases **(()) (25:24)** limits of the short-term memory. And so, by doing that, by using this prosodic boundaries, they are able to understand chunks of text which helps them in understanding meaning.

Now, experienced readers they tend to read faster suggesting that reading has become an automatic process for them. Measurable differences in reading speed and reading comprehension can already be detected in the first grade elementary school while reading is first thought. Reading is actually a learned skill. It is only reasonable to expect a wide range of outcomes from this kind of a **(()) (25:55)**.

Since reading is something which we learn, which is learned over a period of time, and so a wide range of outcomes would happen, some would read fast, some would read slow, some will read with a certain ability. So, there is a wide range of outcomes which can come out of it. And so, reading disability they depend on the arbitrary cutoff point on normal distribution.
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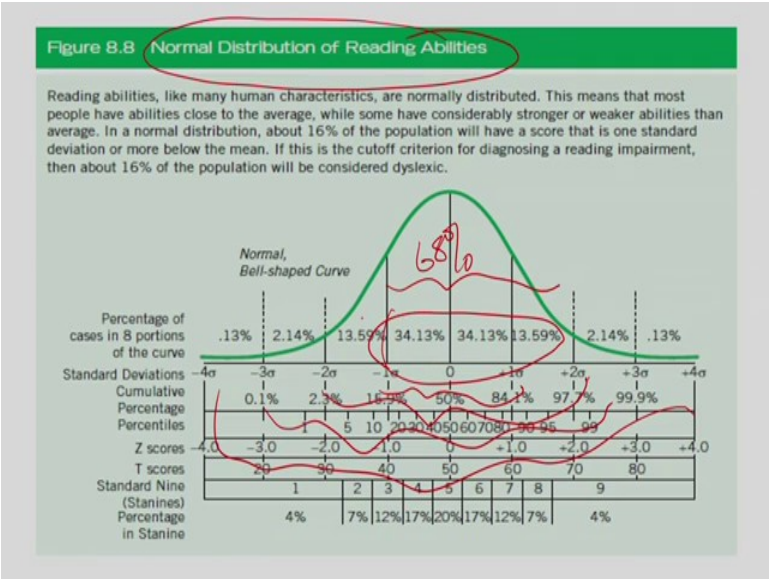

Generally there is a normal distribution, which has been proposed for this reading ability. And, as you can see, this normal distribution says that mostly, so this is a bell-curve, and so

68% population should fall in this, most people have this kind of reading ability. And, as you go further and further away from 1 sigma to 2 sigma to 3 sigma and 4 sigma, you find the disabilities happening.

So, most people have this kind of reading skill development, and as you move away from it, you have reading disabilities. Now, this reading disability gives us a good idea of what can go wrong in reading or in understanding the development of reading in normal populations.

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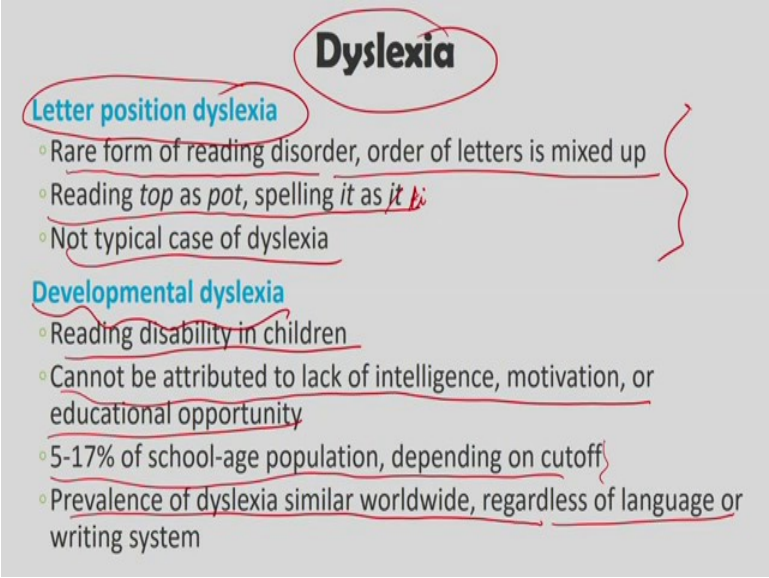

Now, one probable cause of reading deficiency is called dyslexia. Now, what is dyslexia? In dyslexia people are not able to read, people are not able to read properly. It is a form of disorder in which reading ability is hurt, and one form dyslexia is called a letter position dyslexia. Now, what is this letter position dyslexia. In letter position dyslexia, it is a kind of a rare form of reading disorder in which the order of letters are actually mixed up.

In most cases people with dyslexia experiences problem with reading accuracy and fluency. So, what happens is the order of the letters get mixed up and this is one for dyslexia. General dyslexia is a form of reading disability. Now, reading top as pot or reading it as ti is actually a form of letter position dyslexia, not a typical case of dyslexia. So, this is not a typical kind of dyslexia. The commonest form of dyslexia is called the developmental dyslexia.

Dyslexia is a learning disorder as I have explained to you. So, this is a reading disability generally formed in children. It is a reading ability in children that cannot be attributed to lack of intelligence. So, this kind of reading ability dyslexia cannot be attributed to

something called intelligence failures, to motivational failures. It is not that dyslexia happens because of lack of motivation or educational opportunity.

It is that sometimes children get education opportunities, still they have dyslexia, this reading disorder. And so, this form of disorder in which the dyslexia cannot be attributed to intelligence, motivation, or the chances of education is called a developmental dyslexia. Now, 5 to 17% of school-age populations is considered to suffer from a specific reading disorder and this disorder is dyslexia.

As I said, this cannot be attributed to lack of intelligence, motivation, or educational opportunity and 5 to 17% school-age population depending on the cutoff have some kind of dyslexia. The prevalence of dyslexia similar worldwide regardless of the language or writing system. So, this dyslexia is actually prevalent all around the world. It is not that a specific form of language or a specific region of the world has this preference of dyslexia.

So, a genetic component to dyslexia has been found out and it has also been found out that certain environmental factors such as lack of reading material at home put children at a higher risk of dyslexia. So, dyslexia cannot be attributed to certain languages or certain regions. Sometimes dyslexia is related to a certain gene. It has proved that a certain gene is responsible for dyslexia, and other times it is the environmental factors which has been responsible for dyslexia.

Now, developing dyslexia first becomes apparent when the child starts learning to read. The roots of the disorder can be found in spoken language deficits.

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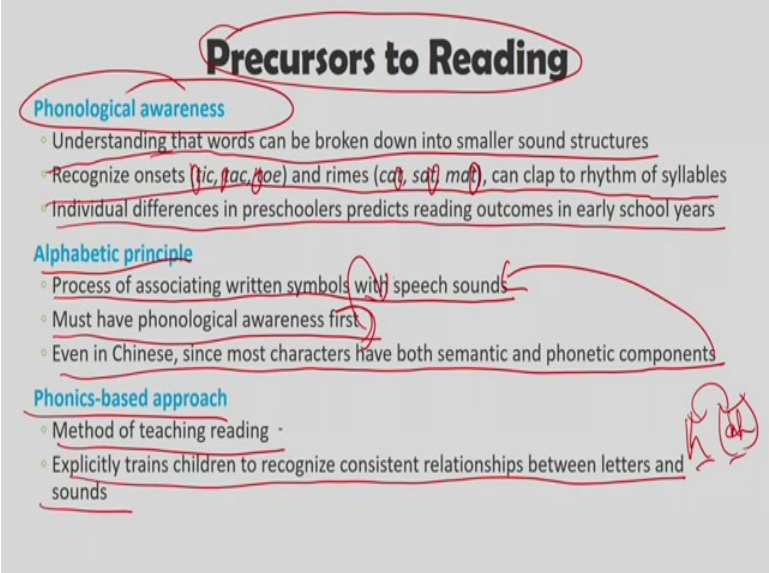

So, dyslexia actually starts when the spoken language is hindered in children. And so, that is the first step that you find in any dyslexia. Through experience with nursery rhymes and language games, preschoolers they actually begin to acquire an understanding how the words can be broken down into similar sound structures and the insight from a natural language is known as phonological awareness.

Now, children, at the time when they are in their nursery they develop something called for phonological awareness. What is phonological awareness? The awareness that bigger words can be broken down into smaller words through pronunciations, and then, it can be spelled and meaning can be extracted out of it called for phonological awareness. This happens late in children with dyslexia.

What is phonological awareness? It is the understanding that words can be broken down into smaller sound structures, recognising the onset of tic, tac, toe and rhymes cat, sat, and mat can clap to rhythm of syllables. So, this kind of thing happens in smaller children. They understand the onset of tic, tac, toe has the same t word, or trying similarly, example cat, sat, and mat. In this the first letter is rhyming. In this the last letter is rhyming.

For understanding this thing or clapping to rhythm of syllables is something that is called phonological awareness that is present in smaller children. And what does phonological awareness actually do? Phonological awareness help them in understanding learning. Now, people with dyslexia or children with dyslexia do not develop this kind of phonological awareness.

So, individual differences in preschooler predicts reading outcome for early school years. Now, phonological awareness is a necessary precursor to something called reading. For any reading to happen the phonological awareness is the first precursor or the first point which is there. Now, without sensitivity to sound structures of the word novice readers cannot make sense of the alphabet principle.

So, without understanding the word, without understanding how something is spelled, or how something is pronounced, initial leaders or small school children will have no idea of what sense to make out of the word and they will not be able to follow something called the alphabet principle. So, what is the alphabet principle? It is the process by which readers associate written symbols with speed sounds.

So, how h is related to the sound of h, this is called the alphabet principle. Now, in alphabet principle, process of associating written symbols with speech sounds. Here, what happens is, this is the step that happens in preschool where children learn what are symbols actually, how it is pronounced, and what does it relate to. So, if I say h, how does it relate to or what letter does it relate to.

It is this insight that enables the young readers to learn the orthographic rules of language. Here, the children are only successful to learning how to read if they can see the consistent ways of written words mapped to spoken word. And this actually helps them in understanding the language that they are going to learn, their mother language or whatever language that they are going to learn, because this will tell you how deep the orthography or the rules for writing languages are developed.

And, so, they will learn how pronunciation is actually mapped on to the spelling of the word. So, must have phonological awareness. If you do not have phonological awareness, you cannot learn the alphabetic principles, and even in Chinese since most characters are both semantic and phonetic component, we have to follow this kind of the alphabet principles. Although Chinese is a logographic language and so they do not have these symbols and alphabetic system, but still even there, we have to have this phonological awareness.

As I explained before, even in logographic mostly the symbols are used for the phonological value. Now, when the autography is shallow as in the case of the German and Spanish, the reading accuracy is less of a problem then the reading speed. Now, since there is a consistent relationship between sounds and letters in these languages the dyslexic children learn how to sound out written words, but they still struggle with connecting to those words and the meaning in an efficient, fluent way.

So, dyslexics they may learn the form of a letter and they may learn the pronunciation but they do not have this idea or they do not develop this idea of integrating the pronunciation with the symbol of the letter, and so that is one problem which can happen. Now, this is especially true when reading instructions includes a phonic-based approach. So, when reading requires us to use a pronounced based approach into learning the reading or into reading, there the dyslexics are more kind of a problem.

So, what does phonic approach really mean? It is a method of teaching reading that explicitly trains children to recognise consistent relationships between letters and sounds. And so, through this approach what we do is we make children learn how certain sounds are produced and how the sounds are related to certain letters or certain symbols, and how the certain symbols what do they mean in itself, that is called a phonic-based approach of learning.

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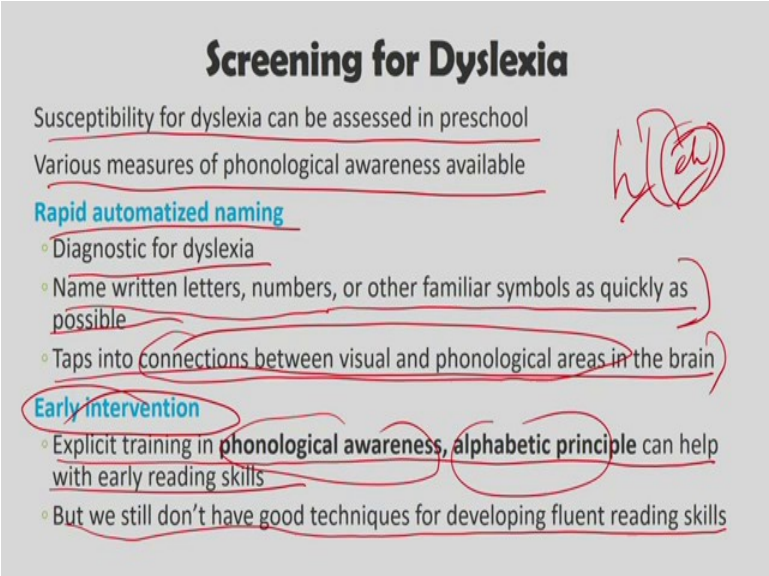

In addition to assessing phonologic awareness researchers and educators can, so how do we screen for dyslexia? The susceptibility for dyslexia can be accessed in the preschool itself. So, one thing that we can do is how do we know the children of dyslexia, we can start with a

preschool screening or screening at the level of the preschool itself. Various methods are available for doing this kind of preschool screening.

One method is called the rapid automatization naming method, that is a diagnostic for dyslexia. Here, name written letters, numbers, and other familiar symbols as quickly as possible, the children have to produce that or to read that, also taps into the connection between visual and phonological area of the brain. So, the rapid automatisation task is the names of written letters are there, of numbers are there, and other famous symbols are there.

Children have to quickly read it and then connect it to the meaning of it or to the symbol of it. And so, what happens is dyslexic children are not able to do that fast enough, and why this is important is because it connects to the visual and phonological area. It shows that there is a connection between the symbol which is the edge that have been talking about and the phonological output or the phone or the word that is coming out of it, so the relationship between that.

So, one way of screening children for dyslexia is using the rapid automatisation type. And so, what we can do, we can do an early intervention if we know that children have dyslexia, one thing is explicit training in phonological awareness, alphabet principal can help with early reading skills. So, we can provide them with phonological awareness and alphabetic principle.

And that can help children becoming lesser and lesser dyslexic or making more dyslexics with training programs for lowering the dyslexic ability in children with dyslexia. We still do not have a good technique for developing fluent reading skills. Now, since we do not have a very good technique for developing this fluent reading skills, it is very difficult to train dyslexic children on it and to improve their dyslexic ability or the reading ability.

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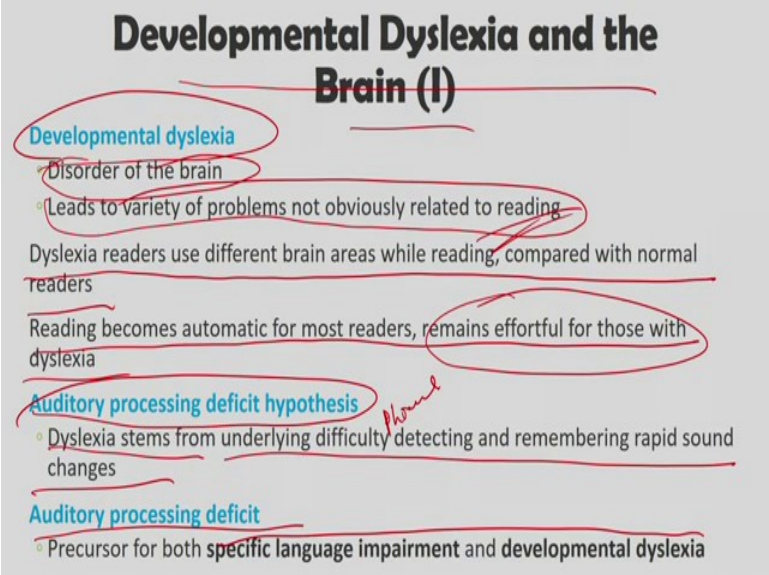

Now, how does the developmental dyslexia relate to the brain. First of all, developmental dyslexia it is a disorder of the brain and it leads to a variety of problems not obviously related to reading. Dyslexia is a disorder of the brain. That is the first thing and the second thing to be noted is that it leads to a variety of problems which are not obviously related to reading itself, there can be several other problems which are related to it.

Why does it happen? It happens because reading processes hitch a ride on the brain system which are originally designed to do other tasks, and variations of the systems can lead to reading disorders. Brain imaging studies have shown that dyslexic readers use different brain areas while reading compared to normal readers. And so, this is one finding which is coming from brain studies that dyslexic people or dyslexic children use another kind of brain area or different brain area altogether.

Now, the standard reading area of the brain is the left temporal-parietal region. The left temporal-parietal region is the standard area for reading in normal humans which is the dorsal stream, but the left occipital-temporal region, the ventral stream are less active during reading task in dyslexic individuals compared to skilled individuals and that produces the dyslexic effect in children with dyslexia.

Now, structural abnormalities in the reading areas can also be found in the preliterate children with a family history of reading impairment. So, structural ability is another reason why dyslexia can happen. So, dyslexia readers uses different brain while reading compared with

normal readers. Also, reading become automatic for most readers but remain effortful for those with dyslexia.

As you can see, with normal readers reading becomes an automatic process, and so normal children are able to do it in automatic fashion. It is something that the symbols are coded by the occipital region and then the meaning is interpreted. It is an automatic process. But we dyslexics this becomes an effortful thing. And so, they suffer from something it. There is something called the auditory processing deficit hypothesis.

Now, children cannot learn to read until they have developed the phonological awareness, that is established. But this will depend even more on some basic processes. For example, the auditory processing deficit hypothesis is a proposal that dyslexia stems from an underlying difficulty in accurately detecting and remembering rapid sound changes. And so, the auditory processing hypothesis is basically centered on something called phonological awareness.

And, what it says is dyslexia is coming from underlying difficulty detecting and remembering rapid sound changes. So, as the sound changes, as the pattern of sound changes, dyslexic children are not able to pick up the rapid changes in sound, and because of that the dyslexia happens in them. There is something called auditory processing deficit. And so, what does the auditory processing deficit actually say? It is the precursor for both specific language impairment and developmental dyslexia.

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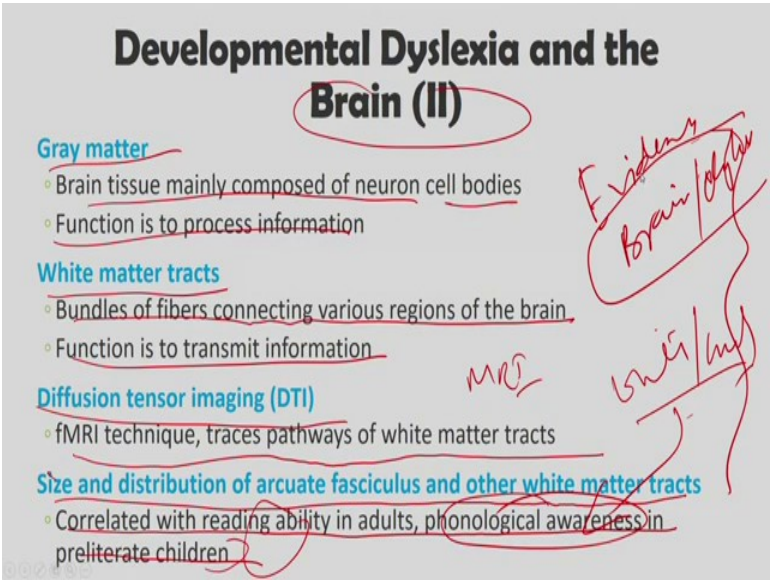

There is also some other facts about the brain and dyslexia. For example, the gray matter, brain tissue, which is mainly composed on neuronal bodies, and functional is to process information. Similarly, we have white matter which is a bundle of fibers connecting the various regions of the brain and function is transmit information. Now, we use something called DTI which is a type of MRI that we do, diffusion tensor imaging, it is an fMRI and MRI which traces pathways to white matter tracts. And what do they say?

The size and distribution of arcuate fasciculus and other white matter tracts that it is responsible, correlated with the reading ability in adults, phonological awareness in preliterate children. And so, these regions, the regions of the white matter and gray matter in brain, the size and the distribution of white and gray matter in the brain, they have a direct relation or they have a direct correlation with the phonological awareness and the reading ability in children.

So, that is another proof or evidence which we have of how brain is related to dyslexia or the reading ability.

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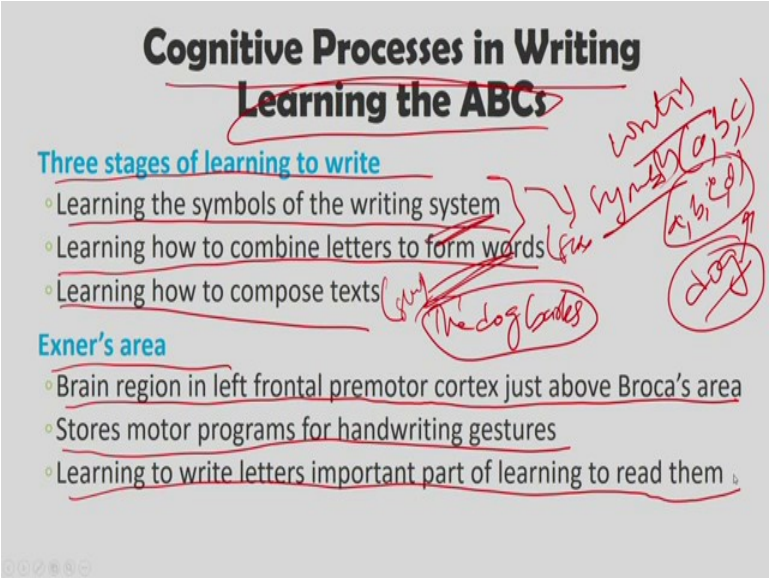

Now, we can actually do certain early interventions, for example, instead of taking a wait and see approach to slow readers, early intervention is useful in dyslexic children. There are simple diagnostic tests such as the phonological awareness and rapid automatisation test that can be used to screen preschoolers for dyslexia. These kinds of pre-interventions will actually help the dyslexics.

So, that part explains what is dyslexia and study of dyslexics also gives us some insight on to how reading is developed and what is phonological awareness and how this alphabet training all this help us in reading. Now, the last section that we have in this particular lecture is to look at all those cognitive processes which are there in writing, that is, learning the ABCs of writing.

Now, there are three stages of learning to write. Any written text, reading and writing are solitary tasks. Now, reading takes years and efforts to learn and not all actually succeed in this task. Learning to write is even more challenging task, one of the most cognitively demanding task that can exist in this world. And so, any learning goes through three stages. Any writing goes through three stages of learning.

Learning the symbols of writing system, the first step in any writing when we write is to learn the symbols. In English, we have to remember what the symbols actually mean. So, the first step of any writing is to learn the symbols which represent certain concepts, certain words, certain meaning, or for that matter, anything. The second step in any writing is to learn how to combine letters to form words.

So, we know the alphabets now. The next step is how do we combine them to form words. For example, dog, now this is a word that I am writing. And so, you have to understand that there are three symbols that I am combining together and they combine together to form the word. So, we have to understand the rules of combining them together, and also, once we have this, what is the meaning of this word.

And the third step in writing is learning to compose text. Once we have dog that is not enough, we should be able to use this dog form some kind of a text, some kind of meaningful text. For example, the dog barks. And so, writing requires us not only to learn this writing system, but also learn the combination of letters, how to combine letters, so basically learning the syntactic rules and composing text which is understanding how sentence comprehension or syntactic rules of sentences are there and how meaning is extracted out of it.

Now, generally, in the brain we have something called Exner's area which is also for exactly the same thing. Now, this is a brain region in the left prefrontal motor cortex, just above the Broca area. And what is the need of this area, what is the requirement of this area? It stores

motor programs for handwriting gestures. Exner's area is responsible for understanding handwriting gestures.

So, no matter how you write, by just looking at the handwriting, by looking at the slants of handwriting, by looking at the gestures that you are making when writing something, this area is able to extract what symbol is being transferred, what symbol is being conveyed, and how this symbol, what is the meaning of this symbol, and what are the syntactic roles related to the symbol and so on and so forth.

So, learning to write letters is an important part of learning to read them. If we are not able to write, we will not able to read. So, learning to write a letter, learning to write the symbol of a letter is the most important part in reading a letter. If you do not know how to write a letter or what does the letter represent, you will not be able to read them. Generally, the Exner's area is the brain region which is located to the left frontal premotor cortex just above the Broca's area that stores the motor program for handwriting gestures.

Now, Exner's area is activated when reading handwritten text, suggesting a process similar to motor perception in speech processes when reading handwritings. Written letters may be essential for learning how to read them, but at least in the case of alphabetic system letter perception and pronunciation soon become automated. As we said that as we progressed in learning, the perception of letters or pronunciation letters both becomes automatic with passage of time.

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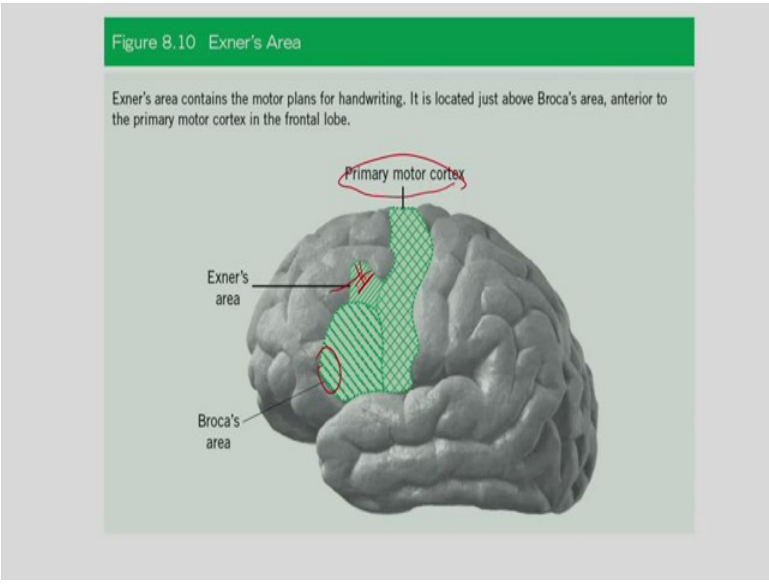

As you can see, this is my premotor cortex area, this is my Exner's area which does this coding of motor movements or handwriting gestures and this is my Broca area.

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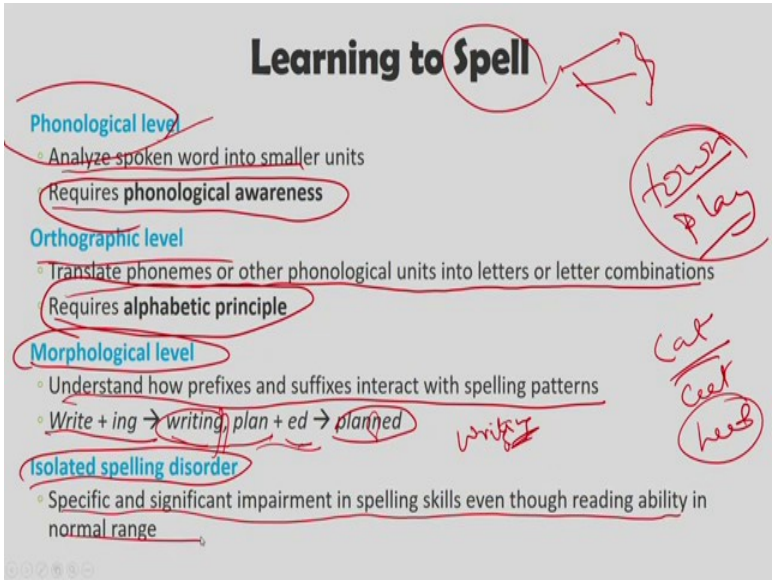

Learning to spell; now an important part of writing is learning to spell. If you are not able to spell, you will not be able to write. So, if you know the exact combination of how a word is pronounced and based on the pronunciation we are able to spell a word. So, learning to how to spell word is more challenging task than learning how to read them, because it requires coordination information about word forms at three different levels.

Now, why it is difficult to learn to spell, because information at three different levels are required. First, at the phonological level, the young writer has to be able to analyse the spoken word into smaller units such as syllables and phonemes. So, learning to spell has integration from three levels. At the phonological level the writer of a word should be able to analyse spoken words into smaller units.

So, that is the first thing that he has to be doing, take the word and break it up into its core word, the lemma word, the extension of it and so on and so forth. And it requires phonological awareness. Only if we have the phonological awareness, you will be able to break the word into sub-processes, sub-word and then the achieve what we want to achieve. At orthographic level what happens is that the novice writer has to understand the rules of interpreting and representing spoken words into written format.

So, how do we write what we are speaking, how do we write it into the actual format, into the written format is the second thing. So, in the orthographic level that happens? Translate phonemes or other phonological units into letters or letter combinations. For example, if I say cat, cat, or heed, how do we write it? That is the basic ting. So, how do we pronounce it, town or play, how am I writing it and how am I speaking it, that is the orthographic level and it requires the alphabetic principle.

If you know only the alphabetic principle, only then you will be able to write the word that you are pronouncing into the actual symbolic form. And the third thing is at the morphological level. Here what happens is the developing writer needs to understand how the structure of the word including suffixes and prefixes interact with spelling patterns. Now, a young writer can simply tract the ing suffix onto the root word write, since the letter e is silent, and it is to be dropped.

For example, look at this, at the morphological level he has to understand how prefixes and suffixes interact with spelling patterns. Now, what happens is the prefixes and suffixes they change the spelling of a word. For example, look at the word that I have here, writing. Rule says that if you add ing into the lemma word it becomes the lexical word that you are interested in or the content word that you are interested in.

Now, write ing into it, so writing plus plan plus ed is planned. You have to understand the young writer or whoever is a novice writer he has to understand that when writing the e is dropped here, the ING, there is no more e here and the e is drop. This is called the morphological level where you understand that you have to drop the e from the lemma level of the word and then include ing.

Similarly for planned, you have to add another n into it, only then we can have planned and plan which is the future tense of plan, and this is the lemma level of any word. Now, some people exhibit an isolated spelling disorder which is the specific and significant impairment in spelling skills even though reading ability is at a normal age. Some people have something called this isolated spelling disorder and what is this isolated spelling disorder? It is a significant impairment is spelling skills though a reading ability in the normal range.

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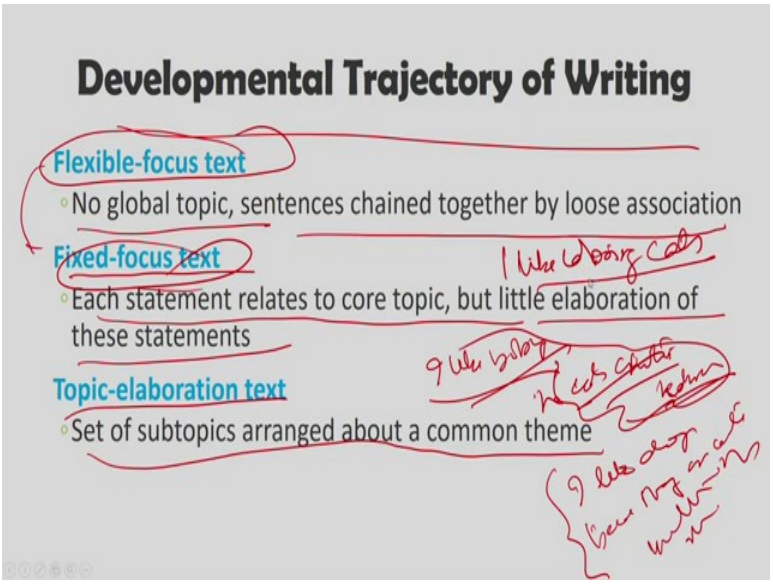

So, how do we try to compose text? Development trajectory in writing, three forms are there in how through development phases children learn writing. The first is the flexible-focus text, no global topic, sentences chained together as a loose sentence. Now, in this kind of flexible-focus text writing children they have no global topic in hand. The sentences are chained together and they form loose association. For example, I like colouring cats.

Now, if you look into this, this is just a sentence, it is words put together, it has no global topic of discussion and so on and so forth. As children progress, they use something called fixed-focus text, in this each statement relates to a core topic, but little elaboration of these statements are made. For example, I like Bobby. He eats chocolate. He drinks water. As I go on and on, I am talking about Bobby and the specific aspects of Bobby.

So, it is related to a fixed focus, but then not related together. And, the third one third form of development of trajectory of writing is a topic-elaboration text the set of subtopics are arranged according to common theme. For example, I like dogs because they are cute, because they are man's best friend, and so on and so forth. Here, there is a similar topic and elaboration of the topic is done.

Here, it is all about Bobby but they are not connected in each other and here there are no connections at all. So, this is how the development trajectory of writing actually happens.

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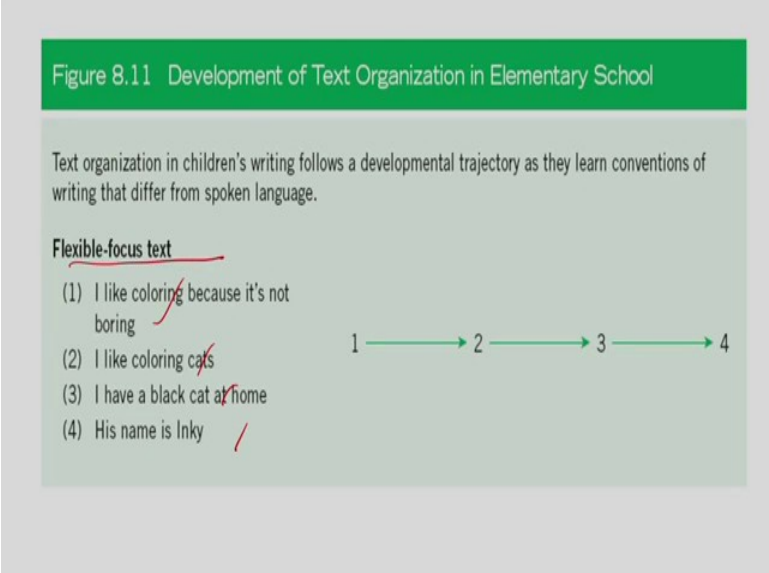

So flexible-focus text, 1, 2, 3, 4. I do not have more of it, but that is how the development of text organisation in elementary school actually happens.

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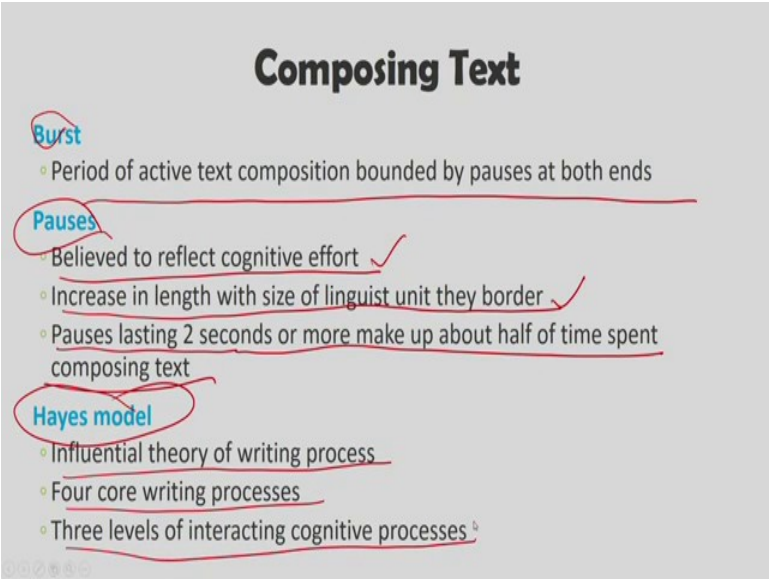

Now, how do I compose text? Texts are composed in terms of something called burst. Now, periods of active text composition bounded by pauses at both ends. When I am writing something, when I am composing a text, I happen to have something called burst. Now, what is a burst? It is a period of text active composition bounded by pauses at both ends. So, when I am writing something in a flow, this is called a burst, and then I wait for it. Now, this waiting period is called a pause.

And when I am writing something fluently, this is called a burst. When I wait after writing something fluently it is called a pause. What is pause? Pause is believed to reflect cognitive

effort. What am I doing in a pause? Increases the length with size of linguist unit they border for 2 seconds or more and make up half the time spent in composing text. Generally, either I am reading what I have written before or the next thing that I can be doing in a pause I am thinking about what has to be written after it.

And this is what it is, so it is a cognitive effort which is there, increases in length with the size of the linguistic unit they borders. So, if they are bordering sentence, it is shorter. If they are bordering a paragraph, the pauses are greater and pauses lasting 2 seconds or more make up more than half of the time spent in composing the text. Now, this text writing is being proposed by model of Hayes, it has proposed for writing text.

Now, this is an influential theory of writing processes. It has four core writing processes, three levels of interacting cognitive processes into it.

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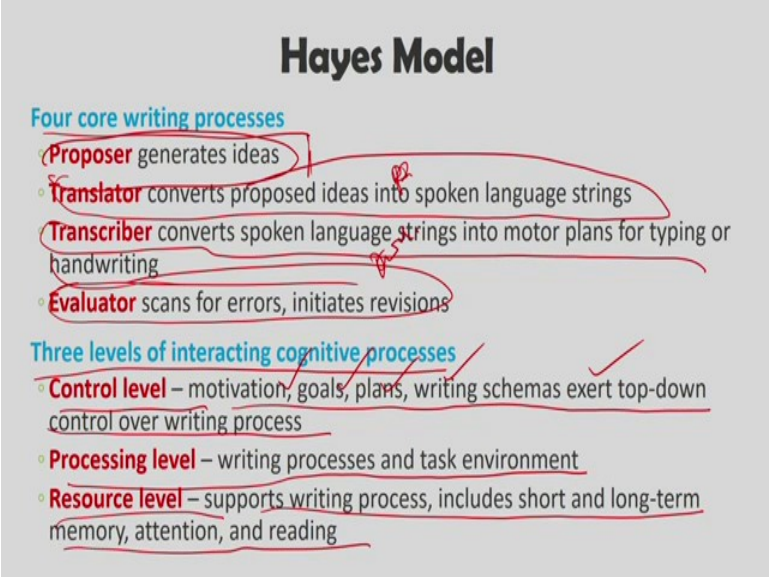

What is the Hayes model? Earlier the Hayes model was a very simple model, and now there is a more generic and more evolved Hayes model. It has basically four core processes as I explained and three levels of interacting cognitive processes. The four core processes are the proposer which regenerates the idea, the translator which converts the proposed idea into written spoken language strings, the transcriber which converts spoken language strings into motor plans for typing and writing, and the evaluator which scans for errors.

So, proposer will generate an idea, the translator will convert this idea into spoken language and written language, and then transcriber will take the spoken language strings and motor

plan for typing so it will convert. So, this is reading, this is pronunciation, and this is writing. From there the evaluator will look at what errors are there. There are three levels of interacting cognitive processes which are working.

Let us think of it in this way, I tried to write an essay on something. The proposer will generate the idea on what. The proposer, what I will do is I look at several texts which are available to me and generate idea from that. And from there, once I had this idea, the proposal will put this idea in the translator who will translate or will put a pronunciation or put into spoken languages of all the ideas that I have.

And this spoken language ideas will then be converted into written ideas through the transcriber. And once the written ideas have been put into this, the errors that I am doing in writing is being taken care of by the evaluator. The three levels of interacting cognitive processes; we have the cognitive control which is motivation, goals, planning, writing schemas exert top-down control over the writing processes.

So, the motivation, the goals that you have, plans, writing schemas, they exerted top-down control process of what you are and how you are writing. The second thing is the processing level; writing processes and task environment. So, what kind of writing you are doing, what kind of pattern, whether you are writing on a paper or on a blackboard, that is task environment.

And the task environment is what kind of information that you have, where the information is coming from, all those will also determine how the writing will progress. And the resource level, for example, supporting writing process includes short and long-term memory attention, reading and so on and so forth. So, other cognitive processes, for example, memory, attention, reading span, and short-term and long-term memory will also decide what you write and how you write.

And so all these psychological cognitive processes and all the four processes they interact together to form the Hayes model.

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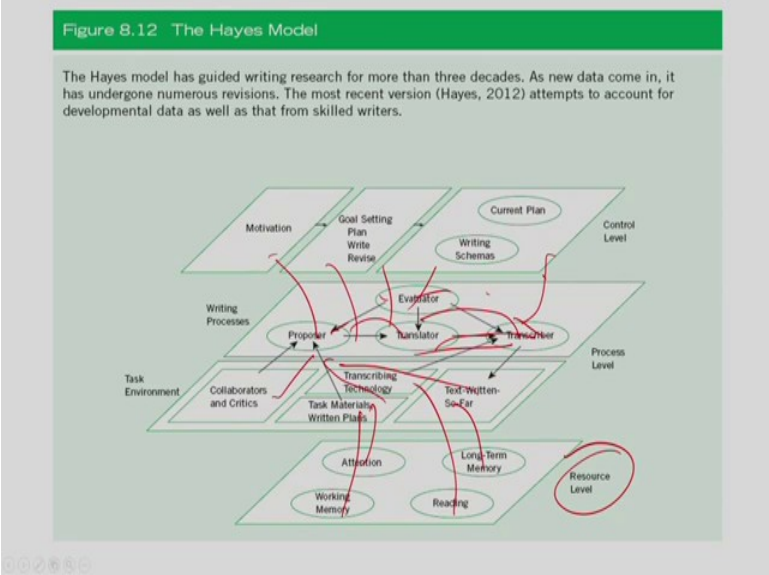

As you can see, this is my proposal, this is my evaluator, this is my transcriber, and is my translator. So, proposer leads to translator, translator leads to transcriber, and transcriber leads to evaluator. The proposer gets information from collaborative critiques and all these task environment variables, and then there is a top down process which tells you whether the writing will progress or not in terms of motivation, goal setting, current plans, and so on and so forth.

And this is dependent on the resource level, the cognitive resources that you have, attention, working memory, long-term memory, reading, so all combined together will tell how successful writing will actually develop.

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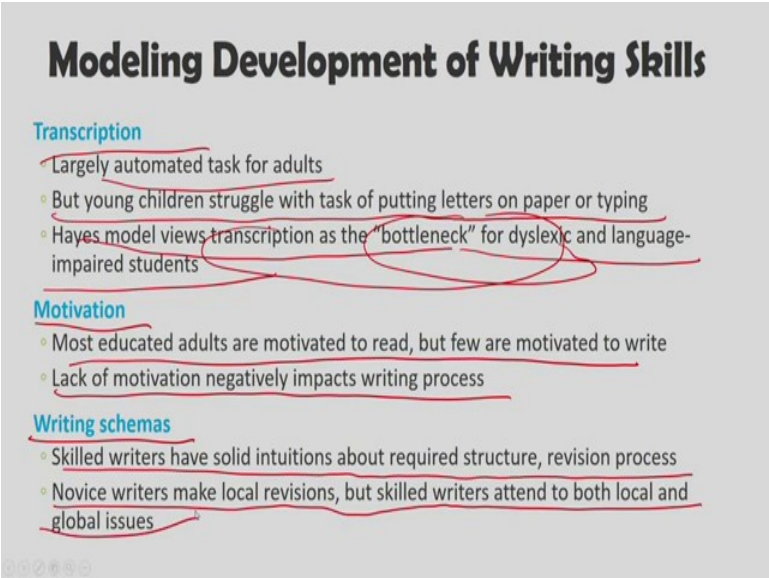

In modeling development of writing skills, transcription, largely automated tasks for adults. Basically, the original Hayes model was a simpler and more described model. So, largely automated tasks for adults, but young children struggle with the task of putting letters on paper and typing. For younger adults, it is easy because writing is an automated process, but younger children they struggle with the task because it is very difficult to write text on paper.

Now, Hayes model view, transcriptions as a bottleneck for dyslexic and language-impaired students. So, they say that the bottleneck is the transcription, which is transcribing what the proposer has into written format is the bottleneck which leads to dyslexia in children. Now, motivation and other factors which helps in modeling in modeling the development of written text.

Most educated adults are motivated to read and write but few are motivated to actually write. So, people would love to read but they are not so fascinated with writing. And that is one of the reasons why you have less development of writing skill. Also, lack of motivation negatively impacts the writing process. Now writing schemas, skilled writers have something called solid intuitions about required structure, revision process, and so on and so forth.

Also, novice writers make local revisions, but skilled writers attend to both local and global process. Skilled writers they look at the whole text and the whole story itself, and based on that they do the writing, whereas novice writers actually process text paragraph by paragraph. Also, skilled writers have these structures, this revision process all in their mind before writing, and so they develop this writing process in a more efficient manner.

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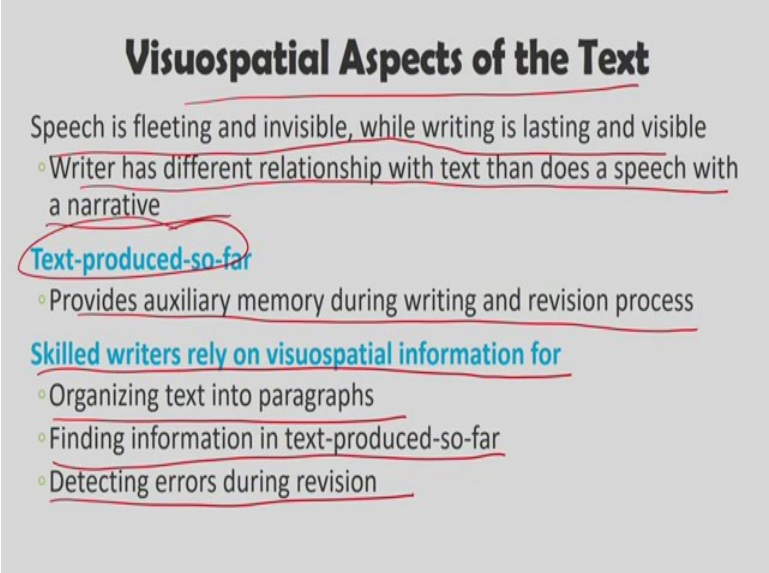

Now visuospatial aspects of the text; speech is fleeting and invariable, while writing is lasting and visible. Writers have different relationship with text as does speech with narrative. Text produced so far provides auxiliary memory during writing and revision process. Basically, written language is literally permanent and laid out in a two dimensional space. What this means is that a writer has a different relationship with the text than a speaker has with the narratives.

Now, when we give a speech, we may forget whether we have already made a particular point or we may inadvertently skip over information we were meant to tell. But when we write we do not have this kind of a memory limitations because what we are writing is in front of us. So, since we can always revive what we have written, that text produced so far serves as a sort of an auxiliary memory and that is what we are talking about.

So, text forms an auxiliary memory. Furthermore, we usually know about where in the text to search for certain pieces of information. Now, to some extent, we rely on the memory of the sequences of ideas in the text to find the information, but we rely on spatial memory as well. We often know about where on a page to find a particular kind of information in a text we are looking for.

Spatial information is important for revising text and more efficient in detecting errors on page boundaries which are visible in text presentation mode, that is when the boundaries are not visible. Now, skilled writers rely on visuospatial information for their texting, organizing text into paragraphs, finding information in text produced so far, and detecting errors in

revision. And that is what skilled writers actually do to writing a text or to writing written text.

So, that brings us to an end on this section on this lecture. Now, I will quickly review what we did in this section. We looked at what is dyslexia and how dyslexia points up into errors in reading. We looked at certain models of reading. We looked at how dyslexia can be a model system to tell you what kind of problems happen in reading. We looked at precursors to reading, those factors which help us in reading, for example, phonological awareness, alphabetic principles, and so on and so forth.

We looked at how do we screen for dyslexia and what are the various brain systems related to dyslexia. We looked at what are the cognitive systems which help us in writing the three systems of understanding the symbol, combining letters and composing text, and also looked at how Exner area plays its role into writing. We looked at how learning to spell has its role to play in writing and we looked at how development trajectory of writing progresses.

We looked at how text is composed and we looked at the detailed Hayes model and what are the visuospatial aspects of any text. Now, when we meet next, we will look at another interesting phenomena in the psychology of language, which is called bilingualism, which is basically how somebody has two languages or somebody uses two languages, what are the principles, what are the natures, what are the factors, all those things we will do when we meet next and discuss bilingualism which is another interesting aspects of psychology of language. But till we do that, it is goodbye from here. Thank you.