Bilingualism: A Cognitive and Psycholinguistic Perspective

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Module - 05
Bilingual Speech Processing part 2
Lecture - 12
Speech perception and production studies

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Hello and welcome back, we are looking at Bilingual Language Processing and so far we have covered patterns of acquisition and usage. So, age of acquisition, pattern of acquisition and L1 to L 2, L1 versus L2 language usage. Now, we will look at language mode, the idea of language mode was proposed by Grosjean in 2001 and 2008 and this basically refers to the state of activation of the languages of a bilingual.

So, when we are speaking in one language, what is the state of activation of the language that is not being used, non-target language so, that is what basically is all about language mode. And the language processing mechanism as per Grosjean theory, language processing mechanism will differ in terms of how active or inactive the non-target language is at that at a given point of time.

So, primarily whether the participant is in a monolingual mode versus bilingual mode or in an intermediate mode, processing strategies will be different. So, bilingual is said to be

in a monolingual mode when interacting with a monolingual speaker in only one of their languages and the same speaker could be in a bilingual mode when there is a bilingual speaker. So, in case of a monolingual mode the other language is said to be deactivated.

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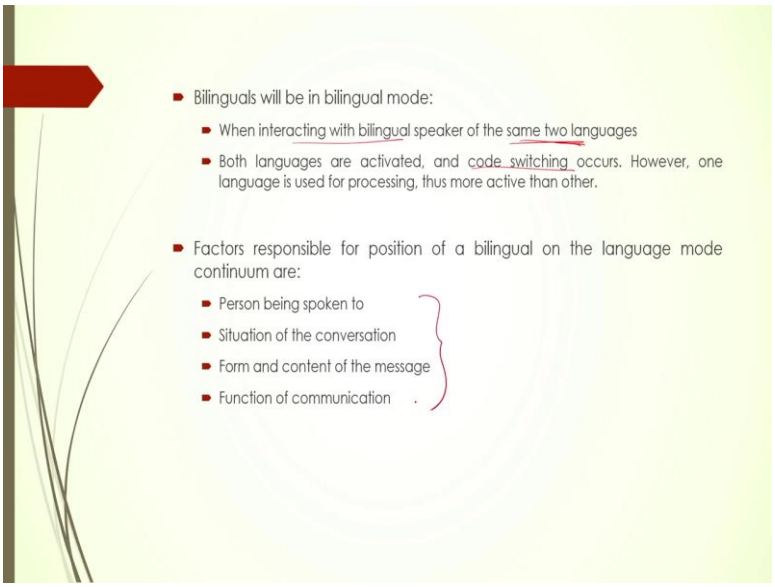

However, when somebody is in bilingual mode, more often than not, the interaction will be happening with a bilingual speaker. So, both speakers are bilingual as a result of which the speaker is considered to be in a bilingual mode and typically the one of the criteria will be that both the speaker both the persons in the conversation are bilingual in the same L1 and L 2.

As a result of which both languages are activated and code switching is often an important aspect of such kind of a conversation. So, that is why we say that in a bilingual mode in the final point of the continuum of bilingual mode there is a amount of quite a bit of an amount of code switching and code mixing that happens.

As a result of which we can safely say that both the languages are not only active, but there also being used at the same time. Hence, this is the bilingual mode. So, these are some of the factors that are responsible for positioning of a bilingual on the mode and this we have already talked about.

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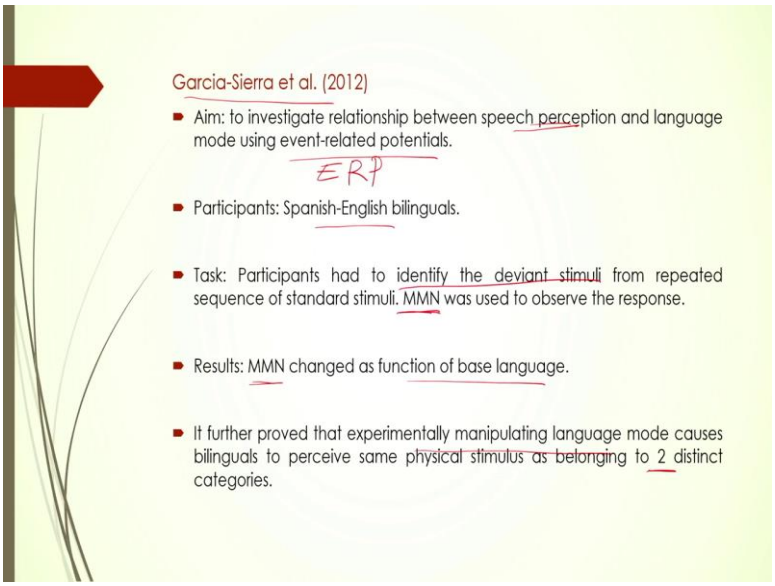

Now, there are various studies that have looked at how the mode can affect the processing strategy. So, one of these studies by Garcia Sierra in 2012, they tried to investigate the relationship between speech perception and language mode and they used event related potentials.

Event related potentials are the outcome of an EEG. So, an EEG machine when it is attached to the head and the participant is tasked with some something and then the resultant signal that the brain emits, which is finally transferred to a computer in the form of a sine wave is what is our ERP. So, ERP is event related potentials.

So, this changes with respect to, as a function of, the stimulus given, as a function of what the participant is doing. So, in this case the participants were Spanish-English bilinguals and they had to identify the deviant stimuli from the repeated sequence of standard stimuli.

So, typically what happens in this kind of a study, they will look at the MMN, MMN stands for mismatch negativity. Mismatch negativity is a signal in a very common utilized signal in ERP, that looks at the mismatched. So, when you are listening to a series of stimuli, auditory stimuli let us say in a number of series of alphabets or series of phonemes, 1 or 2 of those phonemes are not part of the language that you know.

So, there is a mismatch that happens, so in that case if such a situation occurs if then this kind of mismatch is part of the stimuli, then we will see the MMN effect in the ERP signal. So, that is what they looked at and they found that the MMN signal changed as a function of the base language. So, if the deviant stimuli was not part of the base language they found an MMN effect.

So, this proved that experimentally manipulating language mode can cause bilinguals to perceive the same stimuli belonging to 2 different distinct categories. So, because they manipulated the language mode in this case and tried to see how the brain perceives that deviant stimuli. So, that is what they found out that language mode has an impact on that and there are many other studies as well. So, this is just one of the better-known ones.

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Now, we will look at the speech processing among bilingual children.

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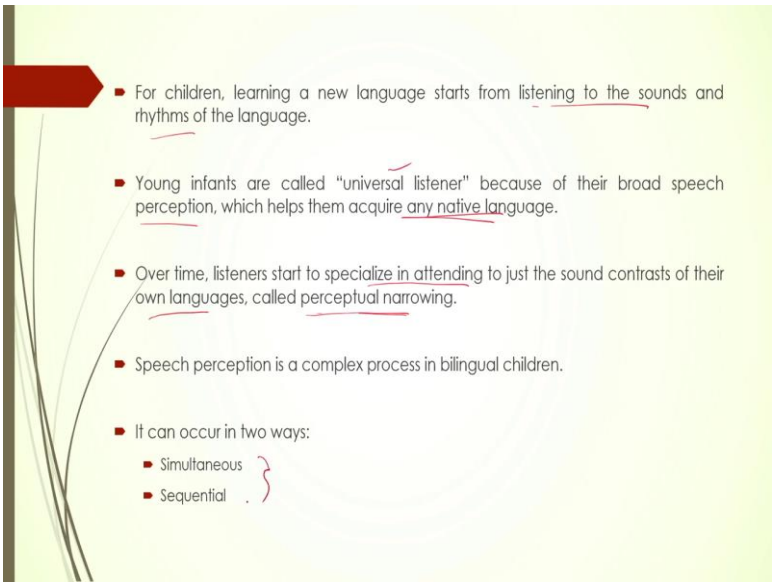

Now, children are a slightly different case as opposed to bilingual adults, because of multiple factors. So, for children learning a new language starts from the from listening to the sounds and rhythms of the language. In the very first stage the child is exposed to, a child first starts to identify the sounds and rhythms of the languages that they are exposed to.

So, very small children, infants, starting from the age 0 a few months few days and all they are called universal listener. They are called universal listener because they have a very broad speech perception domain. So, they can perceive N number of stimuli that is given to them and that is why they are called universal listener.

As a result of this factor children can learn any native language. Whatever language or languages they are exposed to they are capable of learning all of them simultaneously without any problem, because of this factor of being universal listener. So, over time however the listeners start to specialize in attending to just the sound contrast of their own language. Over a period of time and that happens quite rapidly actually.

This broad domain of perceptual awareness starts to shrink and gradually it kind of gets focused on the language of their own. So, the native language that they are learning or that they are exposed to it kind of zeroes in on that after a point of time and this process is called perceptual narrowing.

So, starting with a very broad spectrum any kind of sound and their contrast they can they are open to; however over a period of time, that contrast the understanding of the perceptual contrast, sound contrast gets focused only on the language that they are exposed to. So, speech processing as a perception as a result of this is a very complex process, more complex than adult and this can occur in 2 ways simultaneous and sequential.

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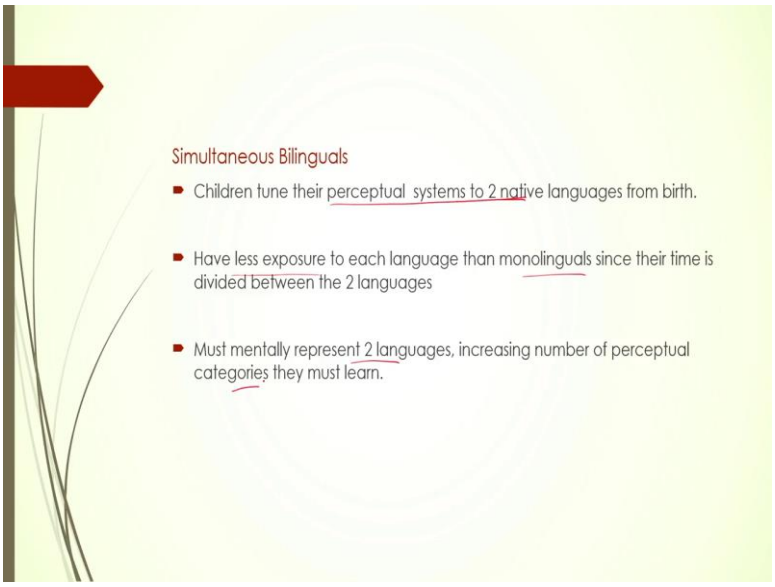

We have seen simultaneous bilinguals and sequential bilinguals, this is related to that idea. So, simultaneous bilinguals just to brush up; they tune their perceptual system to 2 native languages from birth. We will not call them L1 and L2 because they both the languages are being learned at the same time.

So, we can call them both as native language. So, at that time if a child is simultaneous bilingual, they will attune their perceptual system to both those languages and as a result of which, they have less exposure to each language than monolinguals. This is a continuous variable that we have been talking about.

So, they will have less exposure to each of these languages compared to monolinguals, because the same amount of time they are dividing between 2 languages. Now, as a result of this they must mentally represent 2 languages, increasing number of perceptual categories they also must learn within that time.

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So, also their exposure is noisy, it is called noisy in technically it is called noisy, because bilingual children often have bilingual caregiver, speaking with an accent in one or more languages. In a bilingual simultaneous bilingual environment, there are many possibilities.

One could be that the both the parents speak different languages, another could be that they also have a caregiver third caregiver, who speak another language and they might have act various different kinds of accents and so on so for. A child's brain to make sense of what is happening it has to negotiate this noisy environment. And simultaneous bilinguals need to discriminate and separate their languages and engage in language specific processing gradually.

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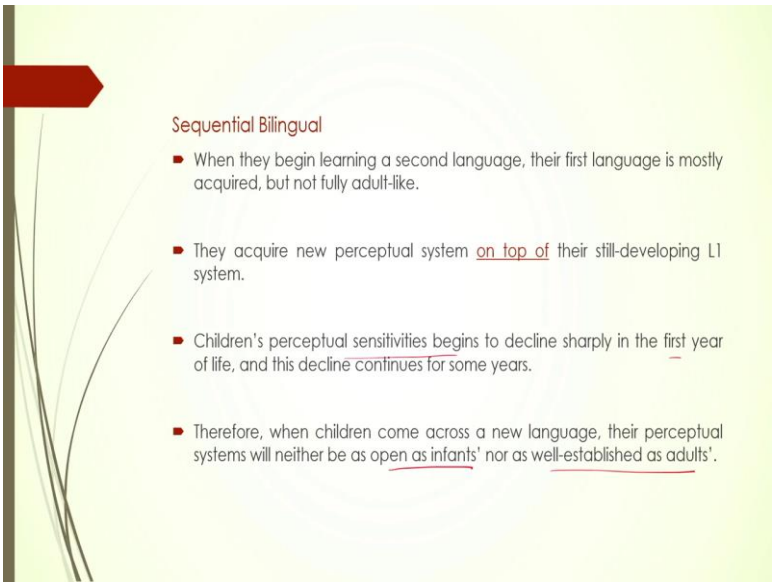

On the other hand, we have sequential bilinguals. Now, when a sequential bilingual is a bilingual who learns their L2 after their L1, so basically, they have an L1 and L2, as opposed to both L1 in case of simultaneous bilinguals. So, in sequential bilingual when you are learning your L2 your L1 is already in place.

In terms of phonological awareness, they have already their phonological awareness of the contrasts and other factors already in place. On top of that now they are learning the L2 phonological properties. So, a new system. So children's perceptual sensitivities begin to decline sharply in the first year of life and then this decline continues.

So therefore, when children come across a new language their perceptual system will be neither as open as an infant’s nor as well established as adults. So, this as a result of which we are looking at it as a separate category. So, infants have as we have seen they are in universal listeners. So, they have a rather open perceptual window and on the other hand adults have already well established perceptual windows.

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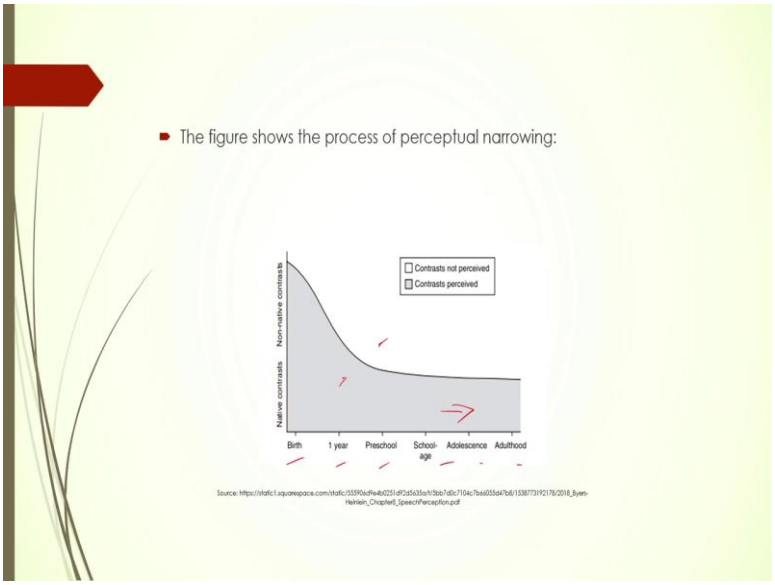

So, this sequential bilingual children; however, are somewhere in between. So, this is what perceptual narrowing is that is what we have talked about. So, contrasts received and contrast not received perceived are the these are the 2 domains that you can see how contrast perceived the domain of perceived contrast can gets broader and broader over period of time. So, birth then first year then preschool as like this, so in adulthood the ability to perceive contrast significantly decreases.

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So, simultaneous bilingual infants now we will look at few studies as to how they have how they have been investigated. In case of infants, it is not the experimental techniques are slightly different as opposed to any other participant because they cannot probably be asked to take part in certain kinds of stimulus and you know discriminating them, perceiving them and so on. So, there is not direct methods as such, because they are not supposed to they cannot be expected to sit down and take part.

So, there are different kinds of mechanisms that are used for studies on infants. One of them is called high amplitude sucking. So, this is a very common procedure used to investigate sensitivities. So, whether a child is sensitive towards one kind of sound or another kind of sound contrast or not so on.

So, this is an indirect method in which they look at high amplitude sucking. So, this is used to assess interest in different sounds; the more the sucking greater the interest. So, this is the baseline. So, 2 variants of this procedure exists; one test discrimination of different sounds and also preference of different for different sounds.

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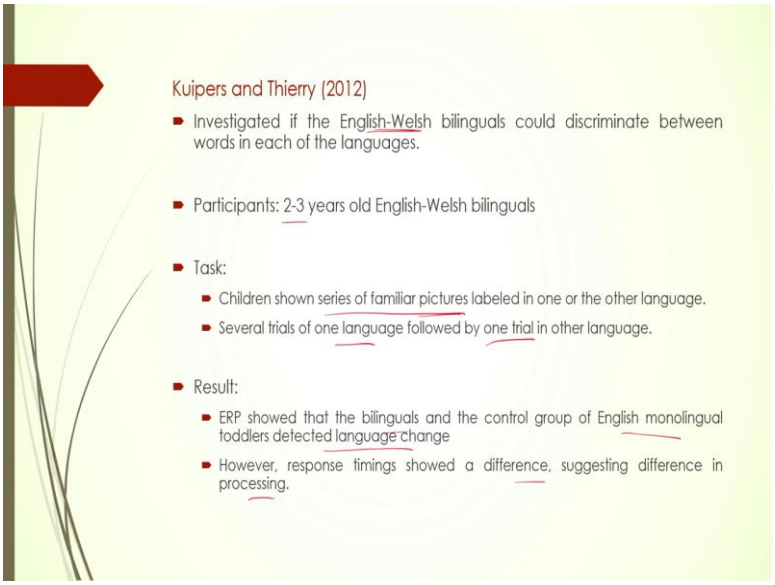

These are the things that are typically studied among infants. One such study looked at if the English-Welsh bilingual could discriminate between words in each of the languages. So, they had very small children, 2 to 3 years. They were not infants, but they were children 2 to 3 years of English-Welsh bilinguals.

The task was: children were shown a series of familiar pictures, labelled in one or the other language. So, some pictures were labelled in English, some were labelled in Welsh and they were shown. So, several trails of one language followed by a trail by one in another language, so they were shown pictures several of one language then followed by another then like this it went on.

This was an ERP study and they showed that the bilinguals and the control group of English monolinguals detected the language change. So, when there was pictures having only English label and then it changed into pictures with welsh label the ERP signals told them that this is that they could change that they detected the change language change.

However, response timing showed a different suggesting difference in processing. So, the brain understood, identified the difference. However, the processing took a little bit of time.

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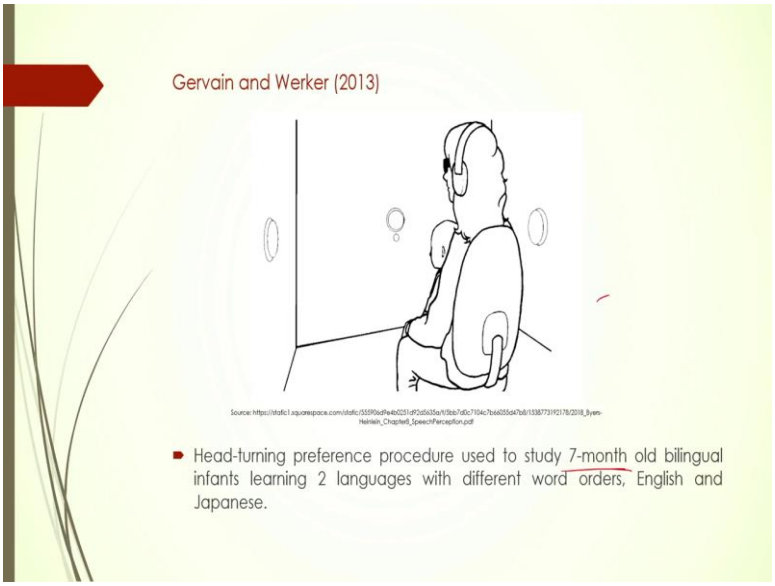

So, the response time was different. Another kind of studies that have used head turning preference used to study this is used to study a 7 month old bilingual infants learning L2 with different word orders, English and Japanese. So, this is how the setting looks. The child will be sitting on his mother's lap and they will listen to various kinds of sound and looking at depending on the head turning preference they will find out how the incoming stimuli are getting processed.

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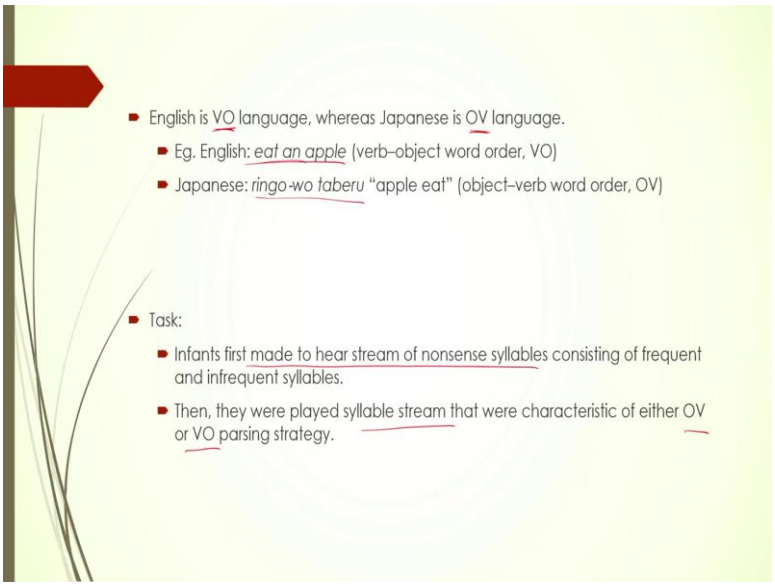

Now, here the bilinguals were English-Japanese bilinguals and so, English and Japanese have opposite word order. So, English is a VO language whereas, Japanese is OV language. So, this is an example of English whereas, Japanese the same sentence will be said like this. So, eat the apple, here it will be apple eat, something like Hindi also, apple khana, apple khao, eat the apple eat an apple ek apple khao. So, similarly Japanese and English have the same kind of opposite of word order.

So, the task was infants were first made to hear a stream of nonsense syllables consisting of frequent and infrequent syllables like this and then they were played syllable stream that were characteristic of either OV or VO. So, first they were made to listen to nonsense syllables and then they were played syllables either in VO structure or in OV parsing strategy.

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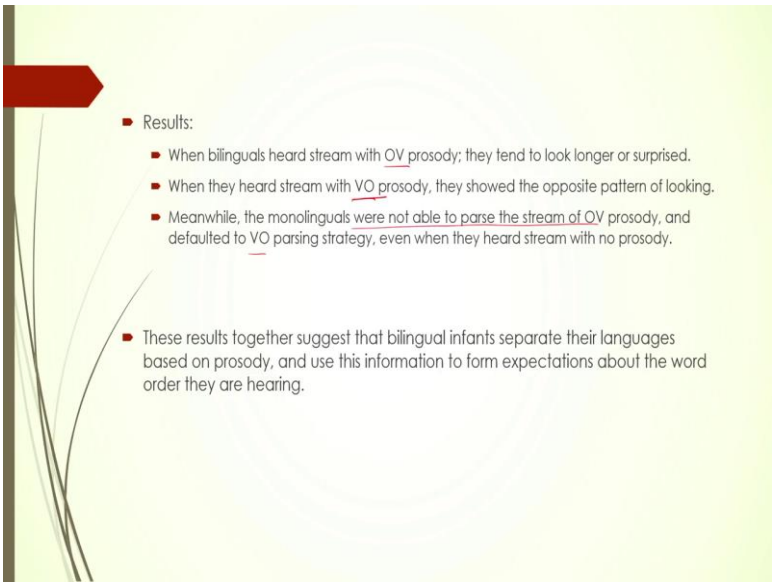

What they found out was when bilinguals heard stream of OV prosody they tend to look longer and or surprised. When they heard stream with VO prosody, they showed opposite pattern of looking, which means the at 7 months of age, the bilingual brain bilingual infant's brain is capable of distinguishing between these 2 patterns.

However, monolinguals were not able to parse the stream of OV prosody and defaulted to VO parsing strategy even when they heard stream with no prosody. So, that is this difference that they found out.

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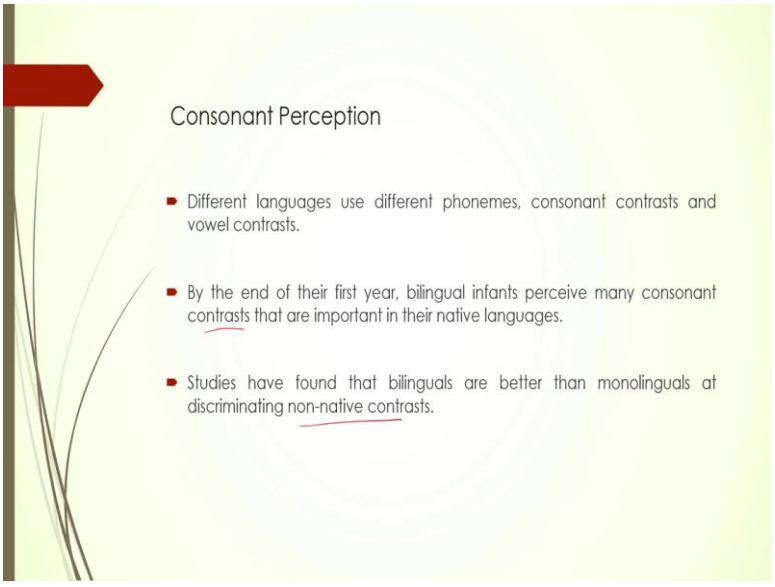

Similarly, there have been studies on consonant perception as well. Different languages use different phonemes, consonant contrast and vowel contrast; so that is a common difference among languages. So, by the end of the first year bilingual infants typically perceive many consonant contrast that they that are important in their native language. So, in for example, in Indian languages, we have within the velar stops we have 4 way difference in terms of voicing and in terms of aspiration.

So, bilingual infants start understanding this, perceiving this kind of contrast in their language, in their the sound of their languages in the very first year. So, studies have found that bilinguals are better than monolinguals at discriminating non-native contrast. So, at by the by age 1 they already know how to contrast them in their native language and they can also do the same in case of their non-native languages.

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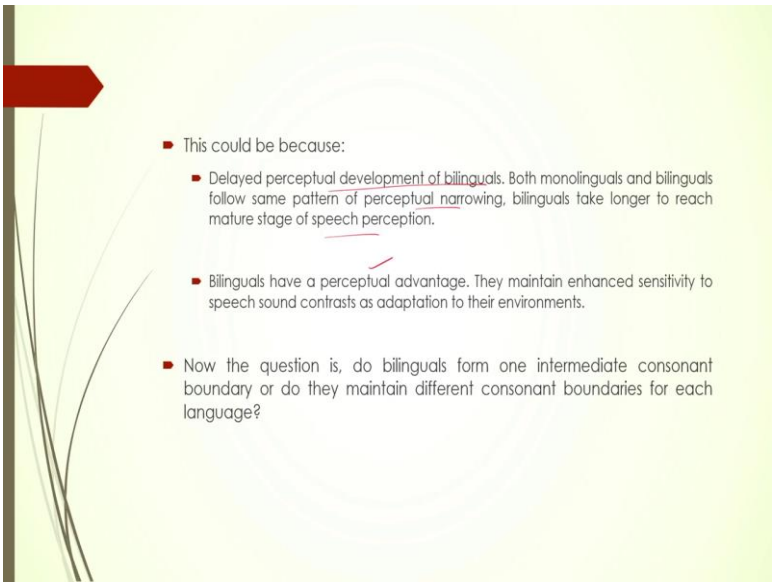

Now, this could be because perceptual development of bilinguals can be one of the reasons. Both monolinguals and bilinguals follow same pattern of perceptual narrowing. This is universal whether the child is bilingual or monolingual, perceptual narrowing happens.

But bilinguals take longer to reach a mature stage of speech perception and bilinguals also have a perceptual advantage. They maintain an enhanced sensitivity to speech sound contrast simply because they are exposed to 2 different languages. The brain is aware of their contrast constantly because of the environment.

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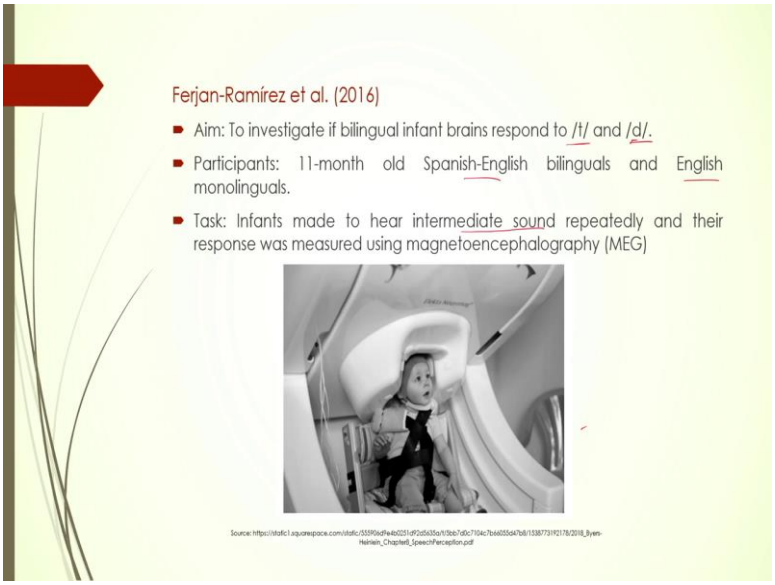

Another study they looked at they tried to investigate if bilingual infant brain responded to the difference between /t/ and /d/ sounds. So, participants were 11 month old Spanish English bilinguals and English monolinguals. So, English monolinguals were the control. They had this was an MEG study. Now, you can see a very cute picture here that that are this is from the study from the paper. So, they infants were made to hear intermediate sounds repeatedly and their response was measured using an MEG.

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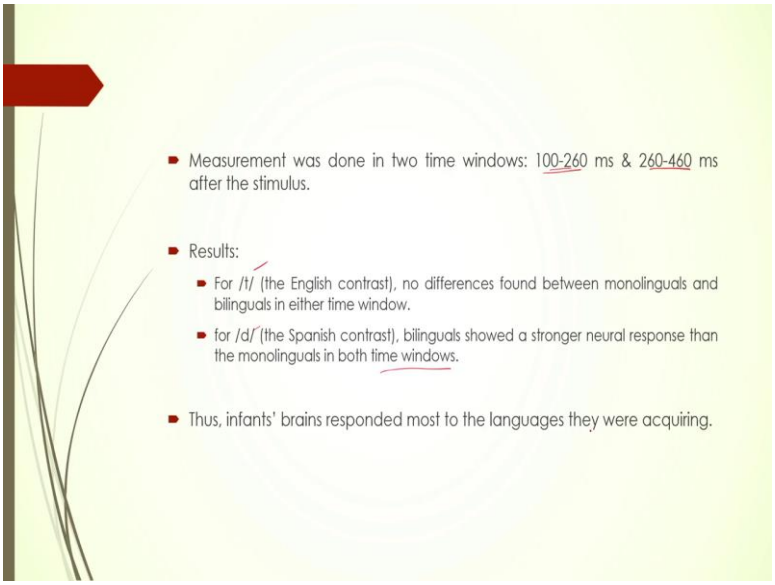

Measurement was done in 2 time windows. There was one was 100 to 260 milliseconds and there was 260 to 460 milliseconds after the stimulus. So, for /t/ the English contrast no differences were found between monolinguals and bilinguals in either time window. For /d/ this is the Spanish contrast. Bilinguals showed a stronger neural response than monolinguals in both time windows. So, by infants brains responded most to the languages they were acquiring which is not the case with monolinguals.

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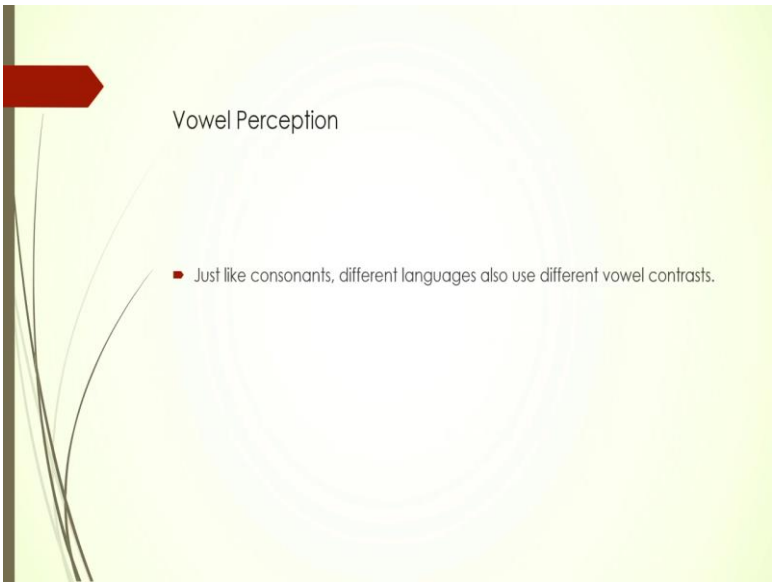

So, that was rather striking finding. Vowel perceptions similarly have been looked at vowel contrast just like we have consonant contrast across different languages. Similarly, vowel contrast have also been looked at.

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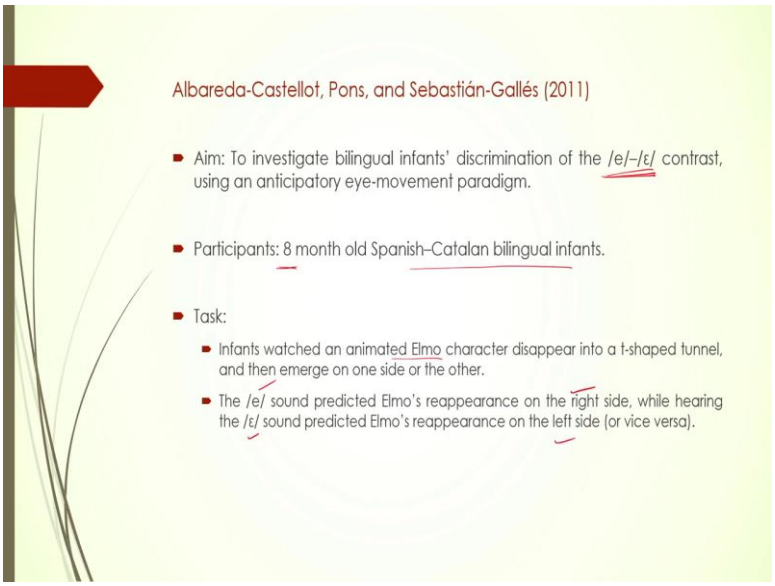

So, there was a particular study that looked at discrimination between the sound /e/ and /Ɛ/ contrast using an anticipatory eye movement paradigm. So, this was eye tracking study. Here again there are children were 8 month old Spanish- Catalan bilingual infants.

So, task was infants were watching an animated Elmo character disappear into a t-shaped tunnel and then emerge on the other side, one side of the other or the other. So, there was a t-shaped tunnel inside with the Elmo character disappeared and then reappeared from there. The /e/ sound predicted Elmo's appearance on the right side and the /Ɛ/ sound predicted his appearance on the left side.

So, this was entirely an animated sort of a task because as we said that very small children cannot be made to take part in a typical linguistic related task. So, this was an eye tracking study where they used animation and there was a connection made between the sound and the site of reappearance of the character.

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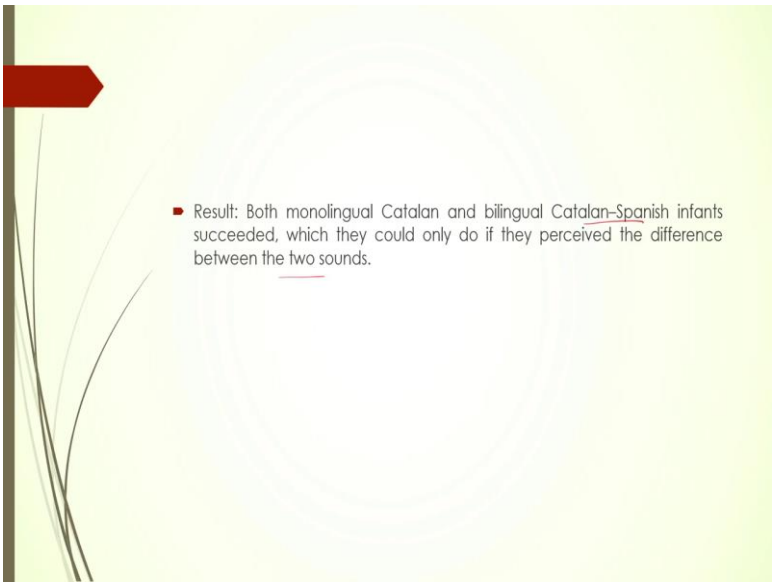

/e/ with right side, /Ɛ/ with left side. What they found was both monolingual Catalan bilinguals, Catalan-Spanish infants; they succeeded which they could do if only they perceived the difference between the 2 sounds because they were already exposed to this.

So, they were so basically if there was a sound and they what were trying to see if the sound /e/ as soon as they heard whether their eyes moved to the predicted position or not. That way they will know that this contrast between the 2 sounds have been identified by the brain and the bilinguals and monolinguals were found to do well, because this contrast exists in their language.

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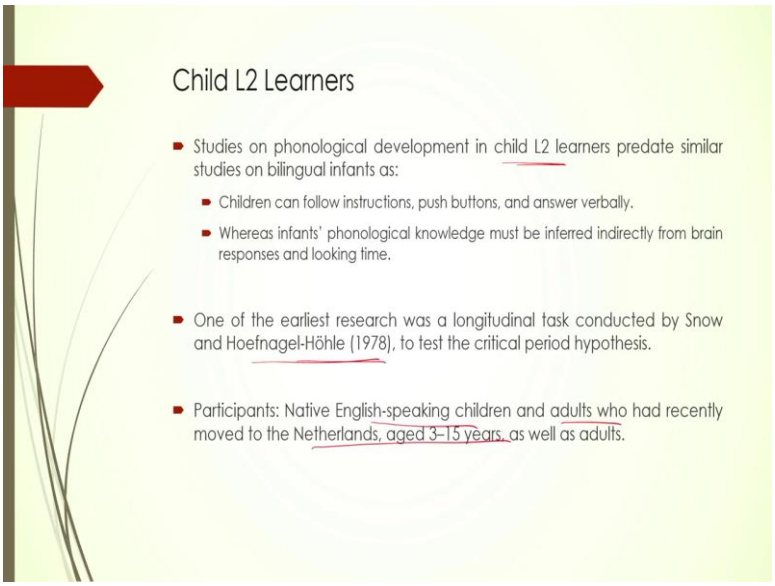

Then child L2 learners, so these are second language learners, they are not simultaneous, they are sequential bilingual. What they are studies on phonological development in child L2 learners predate their similar studies on bilingual infants naturally, because these children are slightly more capable of handling an experimental set up.

So, these studies have been taking place for quite some time. However, in studies on infants are pretty recent, because only now we have sophisticated machinery that will not scare the kids off. So, and also the various paradigms that have been developed. So, one of the earlier studies goes back to 1978 on this kind of second language learners among children.

The participants were English speaking children and adults who had recently moved to the Netherlands. So, children and adults who were actually native speakers of English, but living in Netherlands for a long time, so depending on where the age when they arrived, the there were different groups.

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So, the task was many aspects of the participants' L2 knowledge, L2 in this case is Dutch that was tested including grammar, pronunciation, storytelling and auditory discrimination, discrimination between different sounds. So, all the groups improved over the course of testing. So, they were tested on different timelines.

So, they were there was an improvement. Children aged 12 to 15 did the best in any group of any group. This was a very interesting finding of this study and they were found to be doing better than both the smaller children and the adults and even during the first testing session, a short 6 months after arriving in the Netherlands.

So, we even know they had arrived in this new language environment only in the 6 months prior to the experiment. They were still showing much better performance than the rest of the group. As a result of which they concluded that critical period hypothesis, remember we talked about critical period hypothesis during language acquisition module.

So, this study negates the critical period hypothesis, SLA including phonetic perception because this is ages, this is beyond the critical period, after 12 years. So, between 12 to 15 years is not at all within the critical period and still they were found to learn the patterns of language behaviour in their L2 within a very short span of time.

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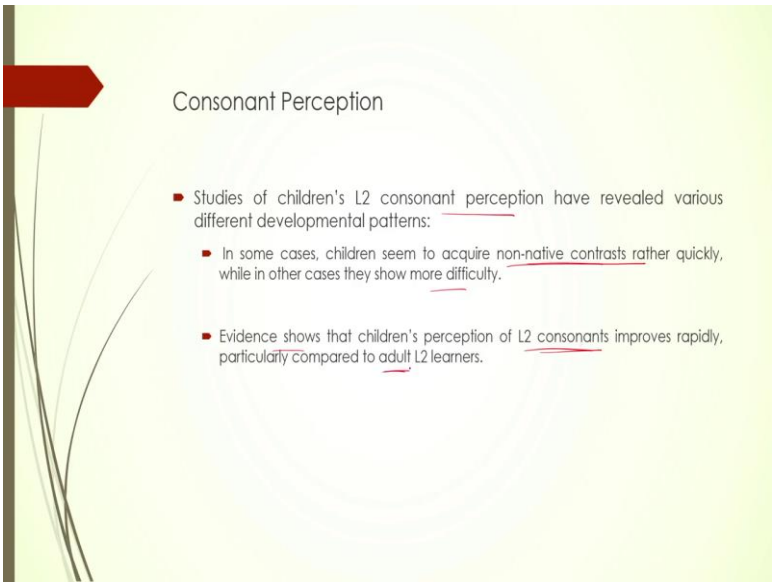

Consonant perception similarly, studying of children's L2 consonant perception have revealed various different development patterns. In some cases, children seem to acquire non-native contrast very quickly, while in other cases they show more difficulty. So, here we see that there it is not a blanket generalized sort of a pattern. There are in some domains we can see a better performance compared to some other domains.

So, where we have evidence that children's perception of L2 consonant improve rapidly, part particularly compared to adult L2 learners. Consonant contrasts and consonants themselves, it is a complex domain of L2 learning and this in this case, children are found to do better than their adult counterparts.

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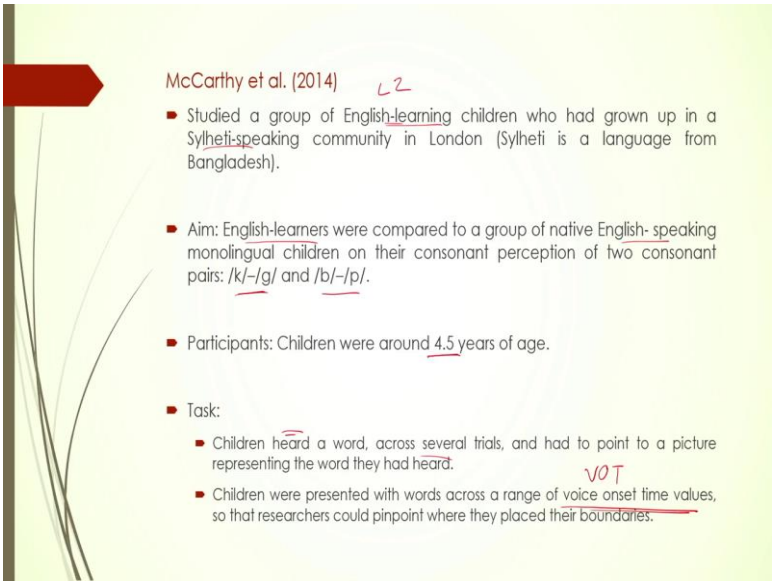

So, in one such study, they studied a group of English learning children. So, English is L2 here who had grown up in a Sylheti speaking community in London. Sylheti is a language spoken in Bangladesh as well as in some parts of Assam in India. So, this is a basically a Sylheti-English bilingual community.

So, English, they were trying to find out English learners, they compared them to a group of native English speaking monolingual children on their consonant perception of the 2 pairs, k/g and, b and p. This kind of contrast they were trying to find out if they are able to distinguish. Participants were small children 4.5 years of age. So, the task was like this: children heard a word across several trials and had to point to a picture representing the word they had heard, ok.

So, they will hear a word and there was a corresponding picture, they had to point to the picture. They were presented with words across a range of VOT values. So, the words had consonants with different VOT. So, that researchers could pinpoint where they placed their boundaries.

So, where does? So basically, the based on the VOT feature, you already know what is VOT? Voice onset time feature, so depending on the VOT value, the sound, the character of the sounds k and g will differ. So, they were trying to find out the boundaries of the sounds or the sound contrasts.

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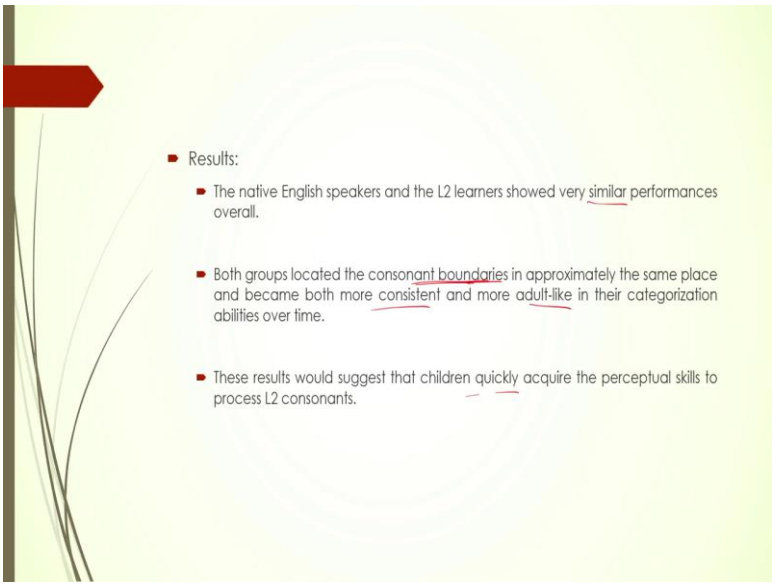

And what they found was, native speakers and L2 learners showed similar performance overall. Both groups located the consonant boundaries in approximately the same place and became both and both more were more consistent and more adult like in their categorization abilities over time. So, they were not doing poorly at all.

This result suggested that children quickly acquired the perceptual skills to process L2 consonants. So, this children were only 4.5 years of age. However, they could their boundaries of these each of these sound contrasts were almost similar to the English monolingual children.

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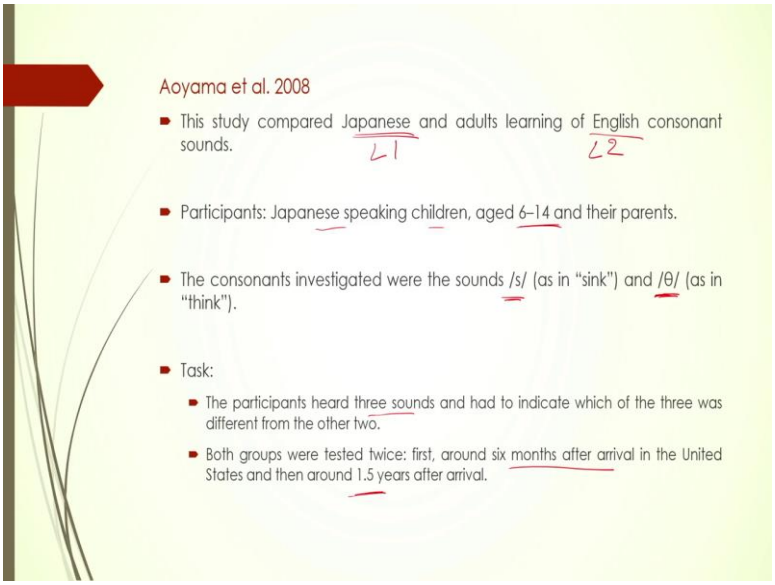

Another study compared Japanese adults, Japanese and adults learning English. So, L1 is Japanese, L2 is English here and they the participants were Japanese speaking children aged 6 to 14 and their parents, so children and parents both were looked at. So, the consonants investigated in this, where the sounds /s/ and /ϴ/ these are both are fricative. So, these are the sounds that they were consonants that they were looking at.

The task was participants heard three sounds and had to indicate which of the three was different from the other 2, so the odd one out test. And both groups were tested twice and first around 6 months after arrival in the US and then again another after one and half years.

So, bit there was a time lag between the 2 tests; once as soon as they are at almost as soon as 6 months and after another one and a half years. So, basically trying to see if their ability to distinguish between the sounds increased over a period of time or not.

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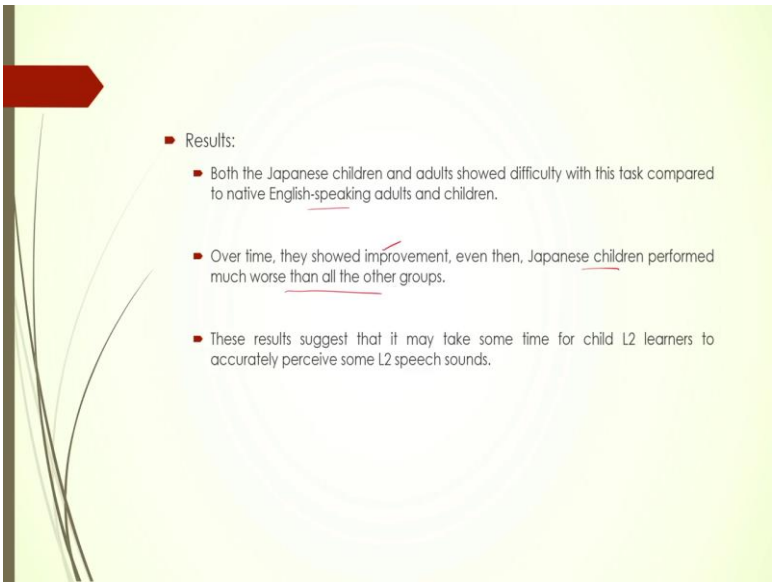

Simultaneously they were also looking at the difference between the children and the adults' performance. So, both the children and adults showed difficulty in these tasks compared to native English as you can already expect. However, over time they showed improvement.

As they spent more and more time in the US English language speaking environment, their capacity to distinguish the sounds became got better. Even then children performed much worse than all the other groups. Now, these results suggest that it may take some time for child children learners to accurately perceive the L2 speech sounds.

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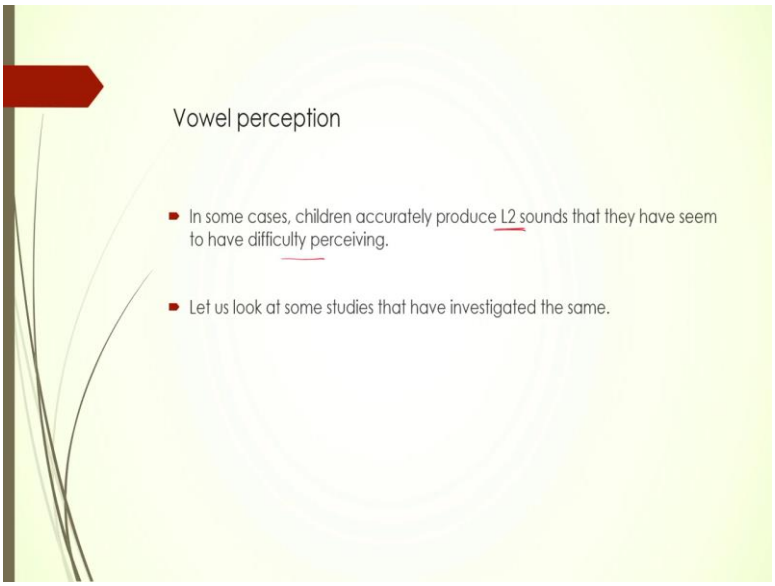

So, there are varied findings in each of these domains in vowel identification, consonant identification, consonant contrast identification, vowel contrast identification depending on various tasks and age group there are different kinds of results that we see.

Vowel perception again in some cases children accurately produce L2 sounds that they have seen. So, sometimes there are differences between perception and production as well. So, while they had difficulty in perceiving, they had done better in production step, for example, producing the same sounds.

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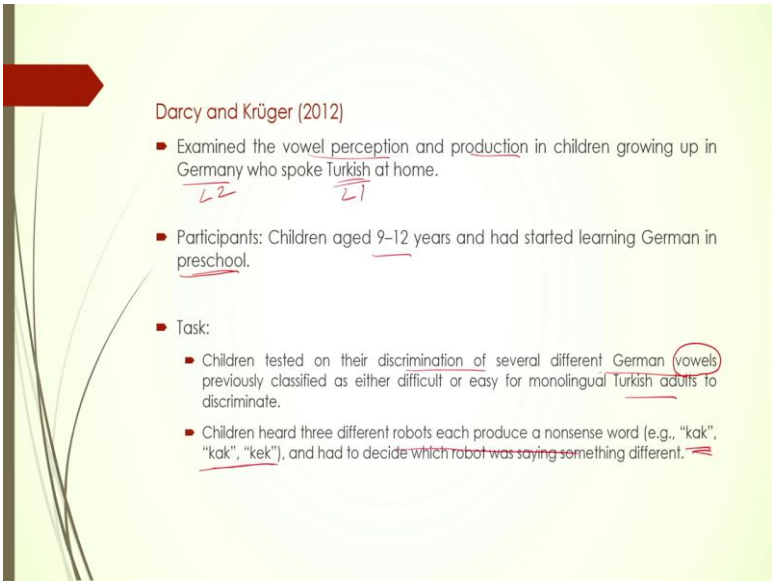

There are all of these differences that have been reported. So, one of these studies is Darcy and Kruger 2012, they examined the vowel perception and production in children growing up in Germany who spoke Turkish at home. So, this is the L1 and this is the L 2. So, German L2 Turkish L1 children, so children between 9 to 12 years and they have started learning German in their preschool.

So, by the time they are in preschool, their L1 is already established and hence they are L2 learners of German in this case. So, the children were tested on their discrimination of several different German vowels, previously classified as either difficult or easy for monolingual Turkish adults to discriminate. German vowel system is different from the Turkish vowel system, as a result of which there are some vowels which are typically more difficult to learn by Turkish monolingual speakers.

So, children heard the three different robots, each produce a nonsense word. These were different they were nonsense word each having a different vowel and had to decide which robot was saying 'something different'. So, they these are the sounds that the robot was producing and they had to find out which was different, which sound was different. So, basically the task was to create nonsense word. And try to see if the Turkish speakers could identify the difference between the different German sounds.

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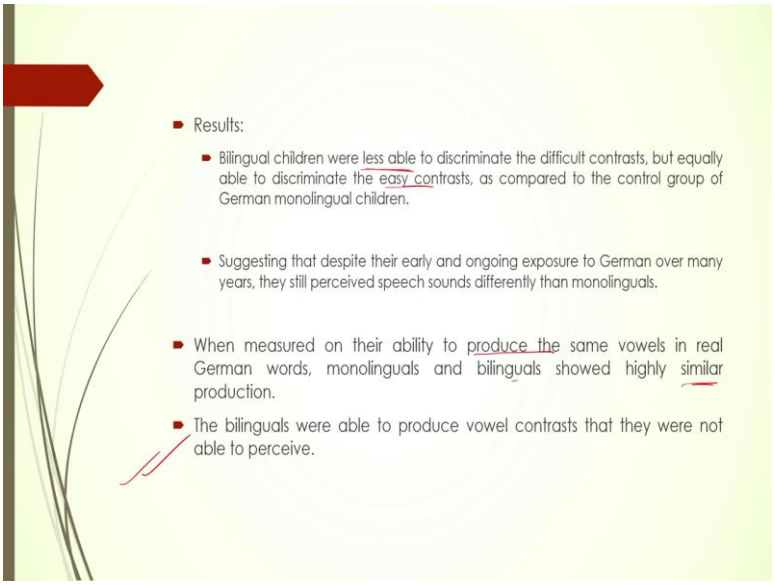

So, the bilingual children were less able to discriminate the difficult contrast, but equally able to discriminate the easy contrast. So, difficult contrast they were found in finding it more difficult easy contrast more easy.

When it was they were measured on the ability to produce the same vowels in real German words, monolingual and bilingual showed simply having highly similar production. What this basically takes us to is that production of the contrast were found to be easier as opposed to perceiving those vowel contrasts.

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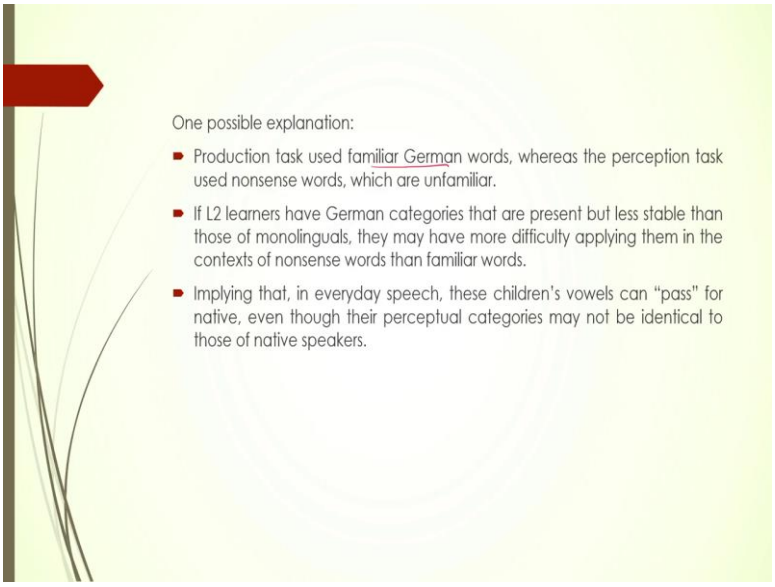

This is something that has been found by many other studies as well and there are many possible explanations that have been put forward. So, production task used familiar German words and whereas, the perception task was based on non-words which could have been in this particular case could have been one of the reasons and there were similarly many other reasons also given.

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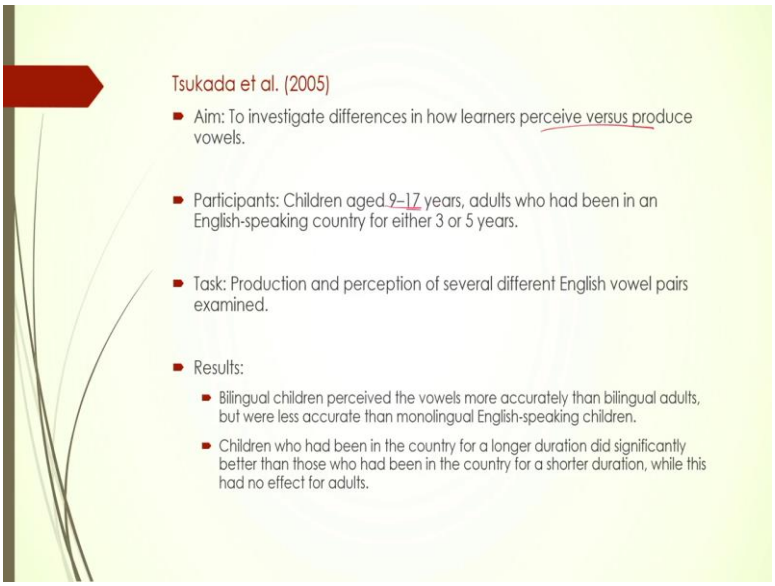

Yet another study looked at differences in how learners perceive versus produce vowels again and here the children were 9 to 17 years and similarly they had done perception and production study.

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These also reveal that unlike the performance on perception, production of the same vowels were as good as the monolingual. So, many studies have found similar kind of performance.

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So, even if perceptions tasks did not have good result, production task on the same vowels showed better results.

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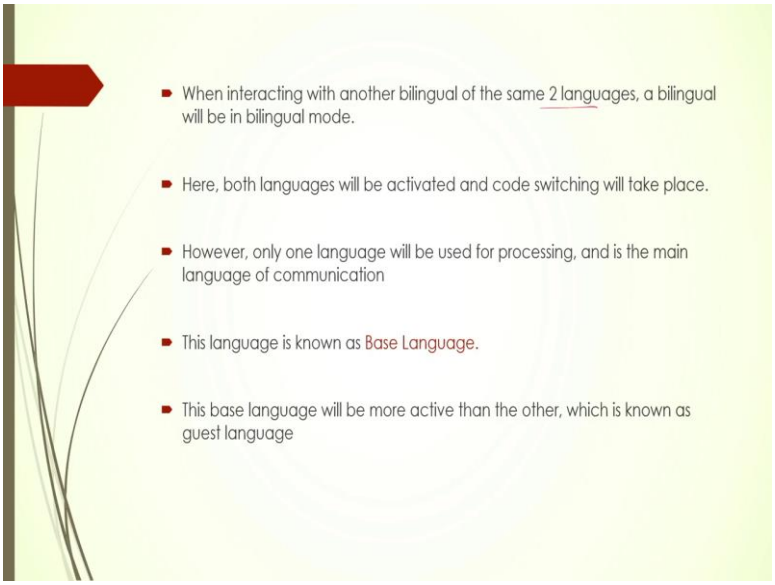

So, what one area within this domain has that has studied been studied is the effect of base language. So, when interacting with another bilingual of the same of same L2 languages, a bilingual will be in a bilingual mode. And this is the case where the base language will seem will have a have an impact on the overall language production and perception.

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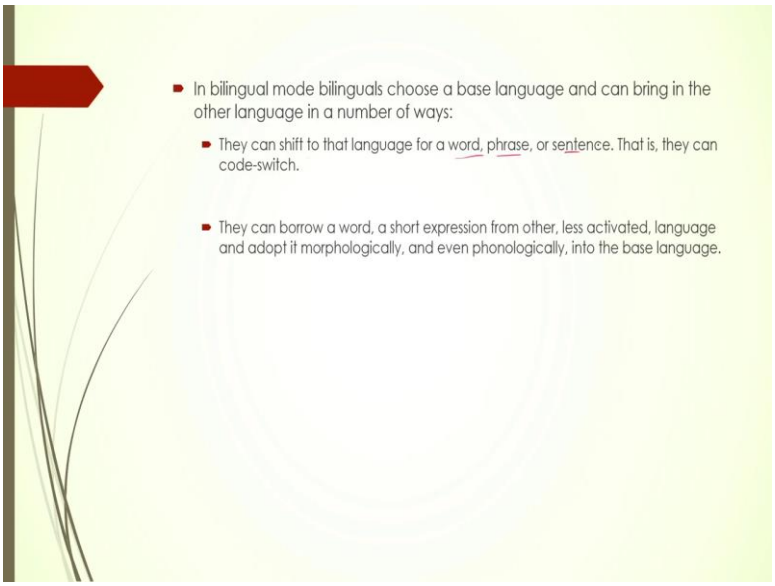

So, this the shift to that language can be for a word, phrase, sentence and so on. So, base language effect is one important area of research within this domain.

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This is still being this is the study in this domain is still undergoing.

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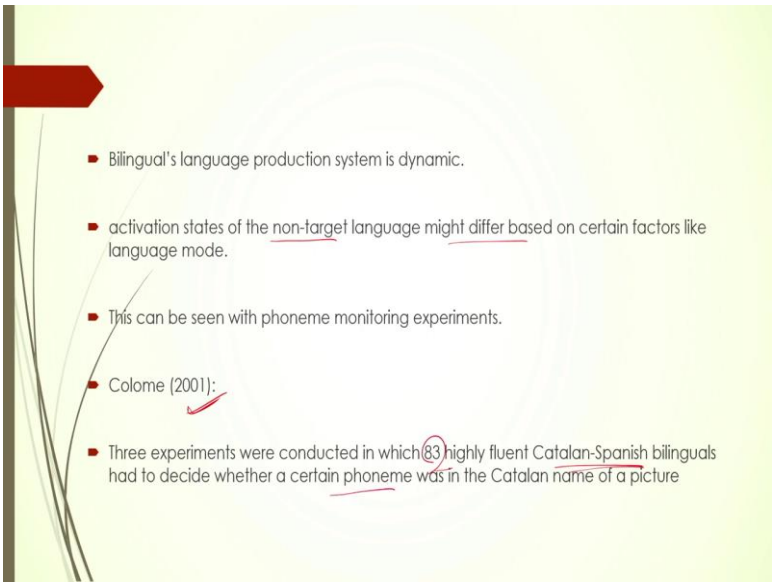

Now, we will look at production system bilingual language production system with some studies. This is again rather vast area of research, but we will try to look at the main points that have been raised in all these years. So, language activation states of the non-target language might differ based on certain factors like language mode which we have already seen.

So, some studies that have looked into this one of the most one of the older studies is above by Colome 2001 and this study looks at how the mode can be changed in depending on the stimulus set. So, they had carried out, she had carried out a set of experiments with 83 high proficient Catalan-Spanish bilingual and they had to decide whether a certain phoneme was in the Catalan name of a picture or not; a simple task of identifying a phoneme. So, they were shown a picture.

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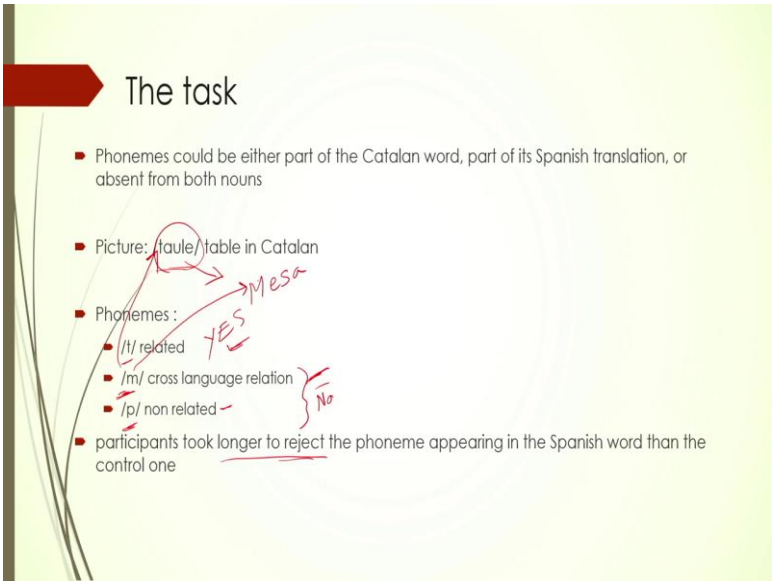

So, the task was like this, there will be a picture of so this picture was which is that of a table. So, the picture of a table the word table is not present in the picture. So, only the picture of a table is there and then after that this is the Catalan name of table and then the task is there will be there will be shown 3 there will be shown a phoneme.

Now, how do you show a phoneme? Phoneme is a sound, a feature of a sound. So, there will be shown letters which has corresponding phoneme. So, there will be shown the phoneme /t/ and then this and then this. How are the different? The first phoneme is directly related to the picture. So, the question to the participants were was this phoneme part of the name of the picture.

So, yes, this is present there because it starts with ‘taule’ or table. But this was this yes question. So, this is called yes trial. So, yes trial is not of interest for this study. What is of interest is the ‘no’ trials, both of these are no trials. So, they had phoneme that was there was /m/, /ma/. Now, why is it interesting? It is interesting because the Spanish name for table is Spanish name for table is ‘mesa’. Hence, this alphabet this phoneme exists, this is part of the Spanish name of the same picture.

Remember, this is the Catalan Spanish bilingual participant and then this sound does not exist in either of the either in Catalan name or in the Spanish name. So, they were trying to see if there is a difference between /m/ and /p/ response. So, both will be ‘no’ answer. The answer will be no for both of these phonemes and they were trying to see if they

take longer to respond to /m/, because /m/ is not present in the picture because the instruction was very clear.

That was this sound present in the name of the picture in Catalan, not in Spanish. Spanish was not mentioned at all. However, if they take longer to respond to /m/, that will mean that they were the second language was activated already. So, the non-target language which is the second language of the other language of the speakers. So what they found was they participants took longer to reject the phoneme appearing in the Spanish word than the control one.

The control one is this one, the unrelated. So, they called one was related, the other was cross-language related relation, third one was unrelated. So, unrelated; obviously, had they took very less time to reject, but the one which is actually not there, but they took longer time is the one that has connection to the other language of the speakers which is Spanish.

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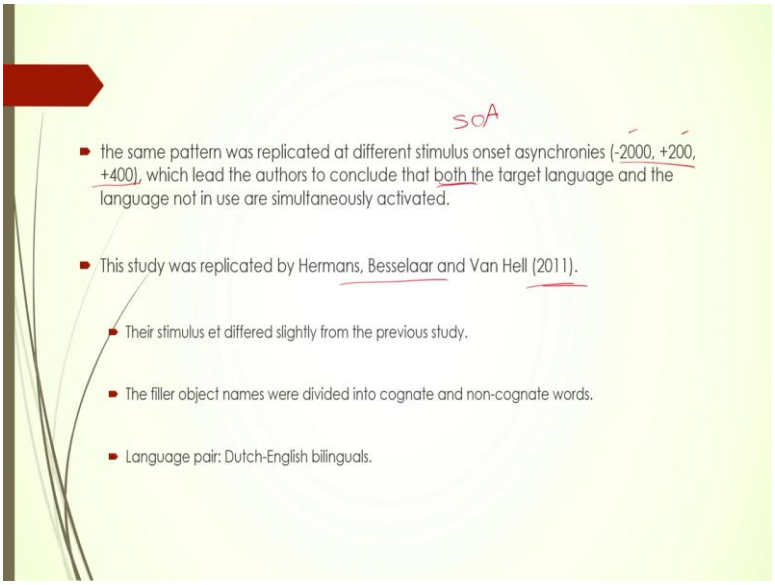

So, this was taken to be a proof of the second language in being active because of the language mode in this particular case. The same pattern was replicated at different stimulus onset asynchrony. So, different SOA, this is called SOA in experimental paradigm. So, and they found same results. So, SOA is basically the gap between the first stimulus and the second.

So, the picture and then after looking at the picture when did the phoneme appear. So, 2000, 200 to 400 millisecond, different kinds of gaps were utilized and everywhere they found the same kind of results. So, they concluded that both the target language and the language not in use were simultaneously activated. Now, this study was replicated after some time, by another group and here they had made some slight changes with the stimulus set.

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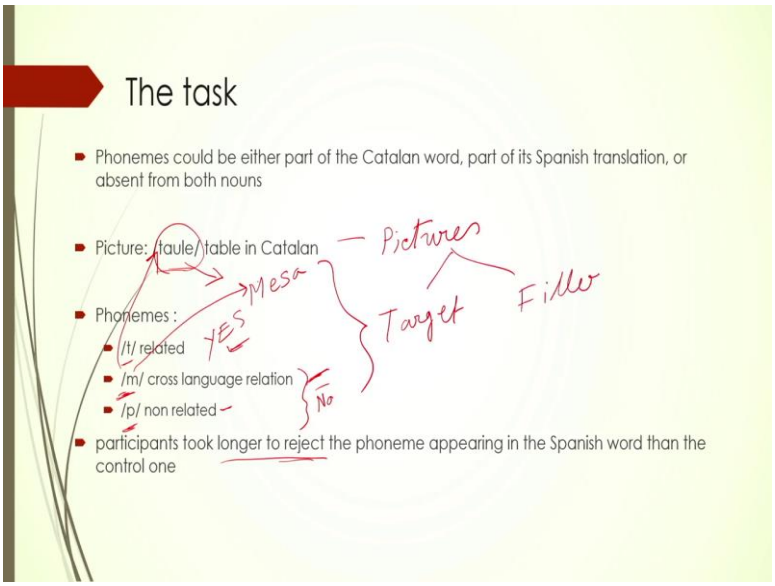

Now, in this study what they did was they were pictures right. So, pictures were some of them were target pictures and some of them were filler pictures. Target pictures had target picture had this kind of a structure. This is how they created the design and they also had filler pictures, filler pictures which were not non target pictures.

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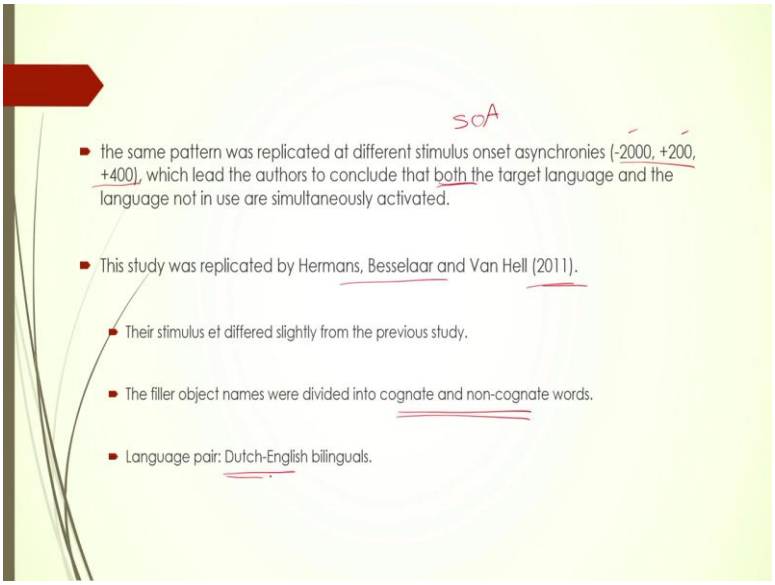

Now, this task was replicated by the 2011 study. However, they made a slight change in terms of the filler pictures. What they did was they had the filler picture the objects that they presented as filler pictures they had divided them into 2 types. One was cognate, the words that were cognate another was non-cognate words. In the previous study they did not really take this as a variable in the study.

However, they had in the filler pictures they had both cognate and non-cognate words as filler words. But in this particular study they tried to look at whether the cognate status of the filler words had any impact on the findings. So, they had 3 different parts of the same study. In one they used cognate, in another they used non-cognate words. Language pair was Dutch-English in this case and the pictures are like this.

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So, they had a again the similar kind of design everything remaining same. The picture was bottle and target phoneme was this, this was the non-target language. So, language cross language condition because the Dutch name for bottle is ‘fles’. We do not know how to pronounce this, but this sound exists in the Dutch version of the same picture and then this sound is not related to either Dutch or English.

So, they found that the pictures were chosen in such a way that half had English names and had a translation equivalent in Dutch like bottle and the filler pictures were whose names were also non-cognate. So, in the first version of the study they had filler pictures which whose names were non-cognate.

The results showed that there was a difference between cross language and non-related identification. So, there was no difference between these cross language and non-related versions. So, when the filler pictures were all non-cognate words there was no difference found in these 2 within these 2 categories.

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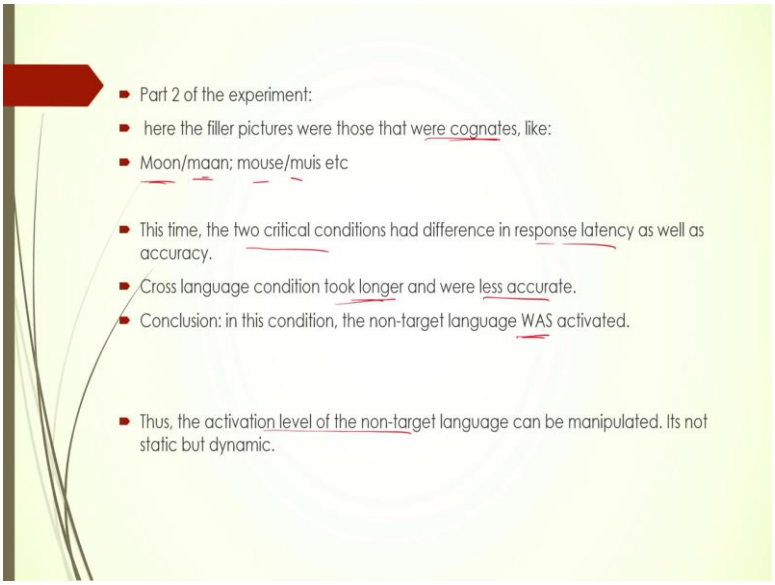

However, part 2 of the experiment they had the filler pictures where those were that were cognates like this kind of these are cognates across the Chinese English language. So, this second part of the study changed the filler words into cognates and this time the 2 critical conditions the 2 critical conditions are these 2.

So, the one which has a cross language a condition and another which is non-related condition. So, these 2 critical conditions had difference in both response latency as well as accuracy. Response latency is the reaction time, the time taken to respond as well as accuracy. So, cross language condition took longer and also were less accurate.

The conclusion in this study was that non-target language was activated. So, you see the difference in this study with the Coleme study 2001 that in the first study there was the fillers were not differentiated in terms of cognate status. In the second study once you change the filler words and look at the cognate status and thereby you create 2 different set of stimuli.

One set of stimuli had non-cognate words as filler words and the other one there were cognate words. When there were cognate words used as filler, they had found a very different they had found a difference in terms of accuracy and latency in the between the 2 target conditions. So, basically what we are trying to say here is that when you have used cognate words as filler words this is indirectly putting the subjects, the participants in this case in a bilingual mode.

And once that bilingual mode has been activated you automatically see the impact of the other language which is not being used currently impacting the reaction time. But if you do not use the cognate words, you are using only non-cognate words; that means they were not activating the bilingual mode. So, the activation level of the non-target language can be manipulated and once that is manipulated you see a very different result in the experimental setup.

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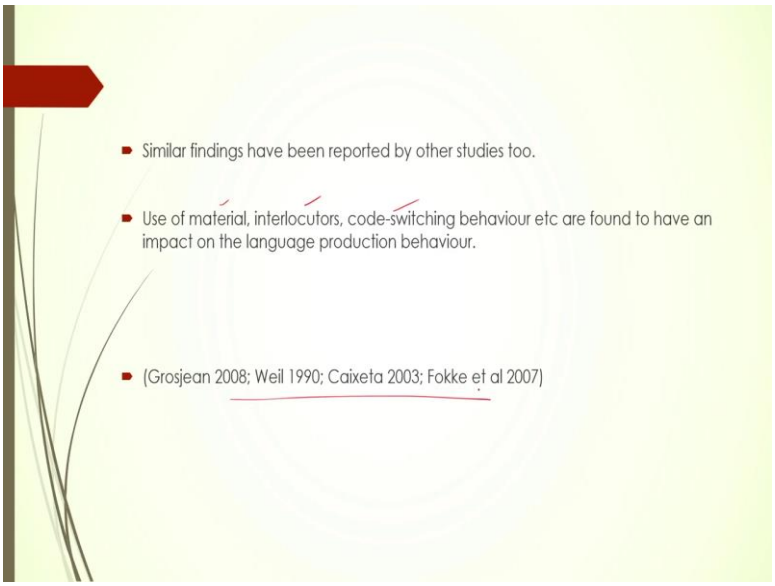

Similar findings have been reported by other studies also. So various, this was only the one domain, but other researchers have looked at use of material, interlocutor, code switching behaviour and so on. Trying to modify using these variables and modulating modifying the test and they found different language behaviours.

So, each of these each of these variables can have an impact on the language mode which in turn will have a different language production behaviour. So, one can look at all these studies, there are many others, but these are the ones that are most well-known.

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Now, we look at. So, we have now we have sort of a baseline created as to what are the different types of patterns that have been observed in terms of bilingual production in terms of speech perception and production. So, perception of sounds and production of sounds, ability to discriminate and so on.

Now, we will look at an overall picture about bilingual language in terms of phonological transfer, so language interaction in terms of phonological transfer. So, I take a long view now and see what kind of interaction happens between the sound systems of L1 and L2.

So, more studies more there are lots of work on L1 to L2 transfer. This has been a favourite of researchers to see how much of your L1 phonological structure impacts the understanding perception as well as production of your L2 phonological structure.

So, we have a lot of studies. There are many domains within which this has been studied, but the most important ones are segmental transfer, featural transfer, suprasegmental transfer and phonotactic transfer. These are the most important ones of course, there are many other domains as well.

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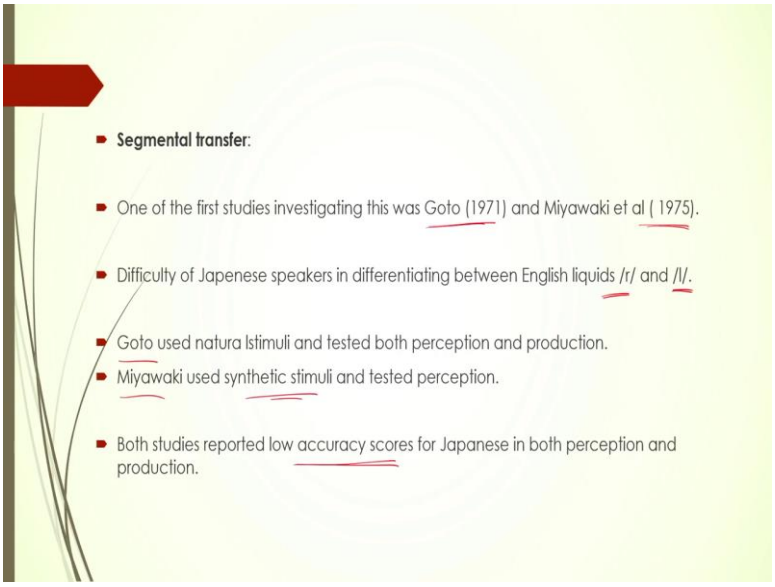

So, let us look at each of them one by one. So, segmental transfer basically looks at the segmental aspect of phonology. So, sounds of one language how they impact sound perception and production of sounds in the second language. This is this study; this line of studies goes back a long time.

One of the earliest ones and most well-known ones are from these 2 studies groups looking at Japanese, Japanese native speakers learning and speaking in English and their difficulty that they find in distinguishing between the /r/ and /l/ sound. So, these are the 2 liquids in English that the Japanese have particular difficulties with and this study goes back all the way to 1971.

So, Goto used natural stimuli and tested both perception and production in English language by the Japanese speakers. On the other hand, Miyawaki uses the synthetic

stimuli and tested only perception. Both of these studies had Japanese native speakers as who are L2 speakers of English. Both studies reported lower accuracy scores for Japanese in both production and perception, primarily taking us to how difficult it is for the Japanese speakers to distinguish between these 2 sounds.

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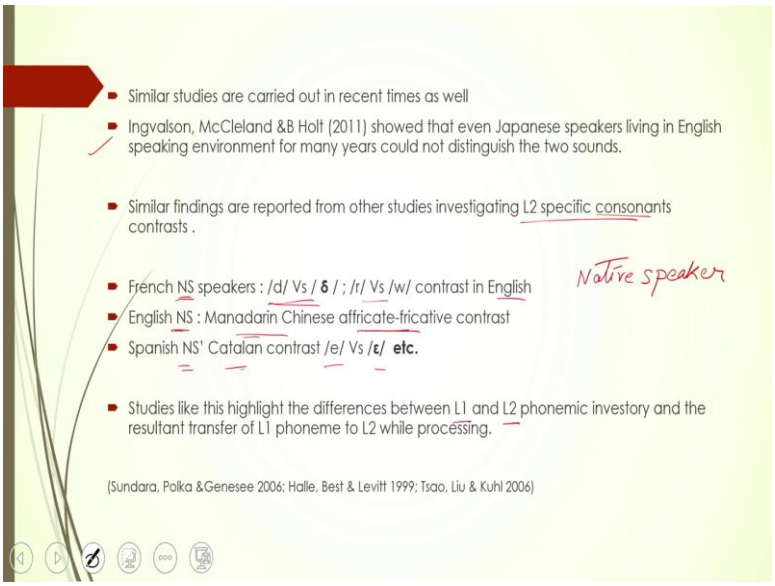

So, these are the older ones. Similar studies have been now carried out recently as well. So, in one such study, they showed that even Japanese speakers living in English language environment for many years still has the same difficulty. So, it is not only when you are learning the L 2, but even after spending years.

Remember, we have looked at this issue before also, that exposure a number of years and age of acquisition, age of arrival in the L2 dominate dominant language environment, all of that typically have been found to have an impact. But in this particular case, the study was replicated on Japanese speakers who have been living in an L2 environment for many years still had found difficulties.

So, they had found similar difficulties in L2 specific consonant contrasts. Similarly, there are many other studies. For example, there are studies on French and in NS stands for native speaker. So, French native speakers trying to identify the contrast between /d/ and /ð / and /r/ and /w/ contrast in English.

So, French speakers who are speaking in English, they have found difficulty in distinguishing different kinds of contrasts that exist in their L2, but not in their l. Similarly, English native speakers learning Chinese language as Mandarin Chinese as L2 have found difficulty in affricate-fricative contrast.

So, Chinese language has affricate-fricative contrast which English does not have. So, as a result of which English speakers when they start learn mandarin Chinese, they have found difficulty. Again, another study with Spanish native speakers looking at Catalan contrast of /e/ and /ɛ/ also found the same kind of difficulty which we have seen recently, which we have talked about. So, studies like this highlight the difference between L1 and L2 phonemic inventory.

So, if your 2 languages have a different phonemic inventory, then there will be a difficulty in terms of what you find easy and what you find difficult. So, if the phonemic inventory does not include /d/ /the/ distinguishing distinct properties or a difference or something or some other such differences, then your L2 has those distinctions, then it will be difficult for the participants to process them, either in perception or in production.

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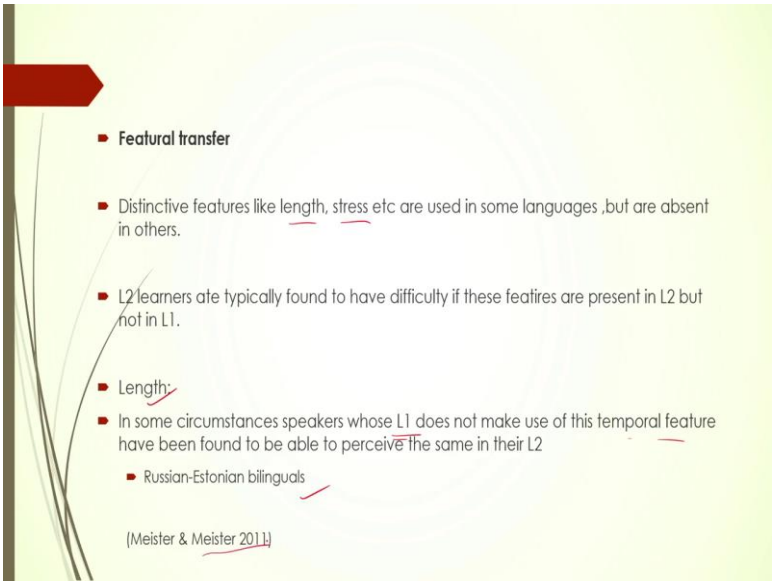

Another area within this is called featural transfer. Now, featural transfers are slightly different from segmental properties. Featural trans properties are like length, stress, etcetera. These are part of every language. So, at the level of sounds, you have sounds and then you have these added properties, which are like length.

So, length long vowel versus short vowel, long stressed consonant versus non-stressed consonant and so on. So, these factors are important variables in certain languages, but not important variables or not let us say they do not exist in the contrast does not exist in some other languages.

So, that is where we also find differences. So, L2 learners are typically found to have difficulty if these features are present in L2, but not in L1. So, length is one such property. In such circumstances, some speakers whose L1 does not make use of this temporal feature have been found to be unable to perceive the same in their L2. So, one such case has been reported on Russian-Estonian bilinguals by in a 2011 study.

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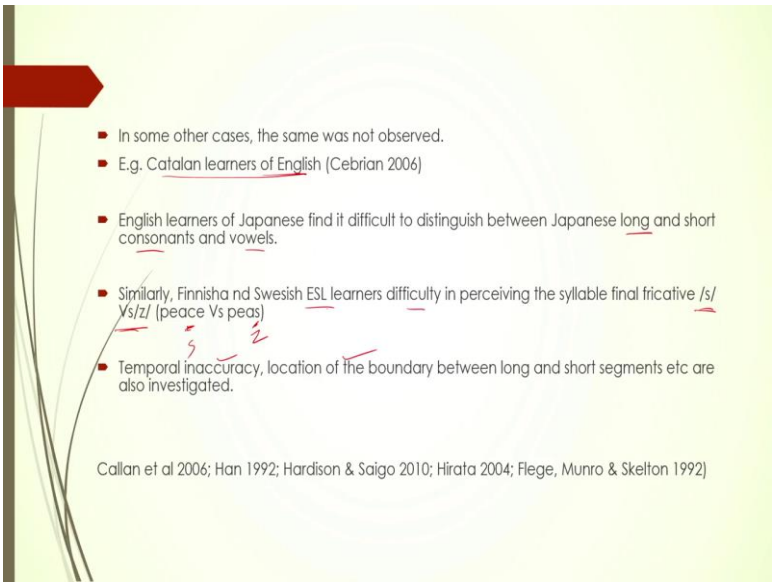

In some other cases, the same was not observed. So, there are some differences in terms of findings. So, Catalan learners of English, they did not find the same kind of results. English learners of Japanese find it difficult to distinguish between Japanese long and short consonants and vowels.

Indian languages also have long short consonant vowel distinction, Japanese also has. So, English native speakers who are learning Japanese, they find it difficult to distinguish between those 2 because English language does not have that contrast. Similarly, Finnish and Swedish ESL learners find it difficult in perceiving the syllable, final, fricative, this difference between /s/ and /z/ sound.

So, in English language, what happens? If this consonant, so, if this is preceded by, depending on the environment of the word, they are realized differently. So, in this case, this will be the /s/ sound, peace and this will be peas. So, the sound here is s, the sound here is z.

Now, this is typical of English, but not of Finnish and Swedish. So, as a result, they found that Finnish and Swedish ESL learners English as second language learners were finding it difficult to make this distinction. This is a very important distinction, what final fricative versus, what final fricative distinction in /s/ and /z/ sound. Similarly, temporally inaccuracy, location of the boundary between long and short segments, etcetera are also investigated.

There in this area has been investigated by various researchers in all these domains of all of these featural domains. So, and they have been, they are important predictors of the difficulties that the learners will face in their L2 perception and production.

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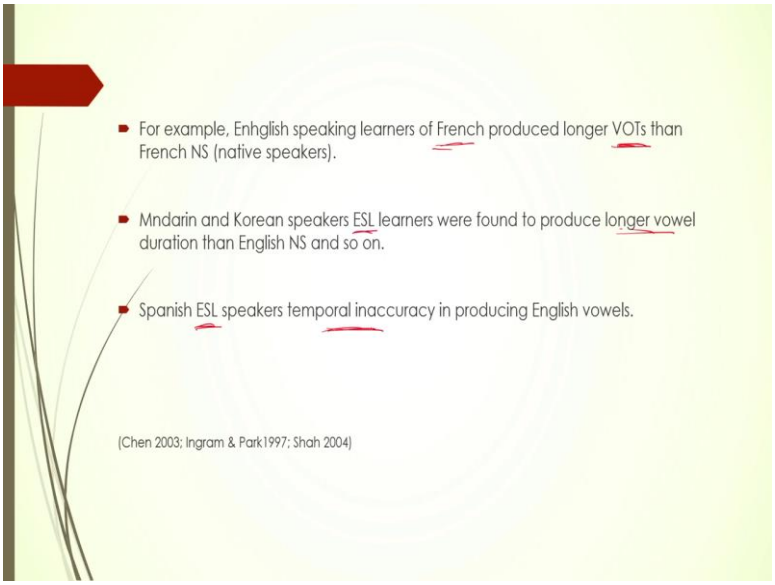

So, for example, English speaking learners of French produced longer VOT than French native speakers, right. Similarly, French has the VOT in terms of VOT French and English have differences. So, depending on if the English speaking learners of French, they are using French then their VOT character itself changes.

Because they bring their own native speaker native language's VOT structure into their L2. Mandarin and Korean speakers of ESL learners were found to produce longer vowel duration than their English native speaker. Because Mandarin and Korean languages have the vowel length, they have different vowel lengths that is there which is not there, the difference does not exist in English language. So, they bring that longer vowel system into English language as well.

Spanish ESL speakers again, they also show temporal inaccuracy in producing English vowels. Basically, in a layman term, this is what we mean by accent. So, accent is they if you ask somebody, he says that you know somebody speaks with a thick accent, somebody has, you know one way of identifying, even if you are not looking at the person, you do not know if you are just given auditory input.

In India, this is quite common, so you were just given auditory input of English language, spoken English language spoken by different people from different parts of the country. So, coming somebody coming from Kerala versus somebody coming from Bengal versus somebody coming from Punjab, you do not really have to look at the person, you do not really need to know who the person is, just by listening to the way English is spoken you will know the person, which part of the country the person belongs to, because we typically say that they have the accent, very strong accent. What is accent? This is accent. So, in terms of linguistics, in terms of phonology, this is what is accent. So, both featural and segmental as well as suprasegmental properties of the sound structure of a language, that is what makes it accent.

So, when you are bringing your L1, suprasegmental, segmental and featural properties into your L2 is what we call you know somebody is speaking with an accent. So, Spanish English ESL speakers, they show temporal inaccuracy in producing English vowels.

So, the vowel length, vowel structure, you know various properties including VOT and etcetera, will be different across languages. So, when you bring that into your L2 is when we find inaccuracy in both perception and production.

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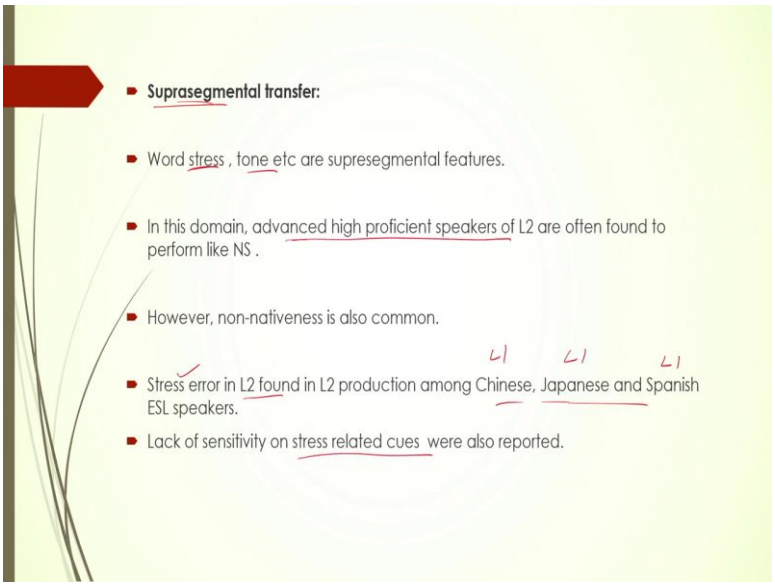

In production, we can talk about accent. In perception, we do not get to see what is happening, but we this is when you need an experimental setup. So, now let us move on to suprasegmental transfers. Suprasegmental transfer, suprasegmental properties are like word stress, tone etcetera.

Tone is a feature of certain languages across the world. Stress is again, stress can be at various levels, word stress you know this stress has many sub-domains within itself. So, in these domain advanced high-proficient speakers of L2 are often found to perform like native speakers.

So, proficiency is a factor. When we say that somebody does not have accent is typically when that person is high-proficient in the second language. So, that is exactly what this finding also suggests. So, non-nativeness is also common. So, some cases, high-proficient bilinguals will show better production capacity. However, in some cases, they do not. So, one of the areas where we find that the L2 speakers will not have a native like pronunciation or production is stress error.

So, stress error in L2 is found in L2 production among Chinese, Japanese and Spanish ESL speakers. So, Chinese L1, Japanese L1 and Spanish L1 speakers who are learning English as second language, they are found to have error in terms of stress, word stress. Lack of sensitivity to stress-related cues were also reported. So, there are cues that were

given in the experiment, but they were not picking up on those cues simply because that does not exist in their L1.

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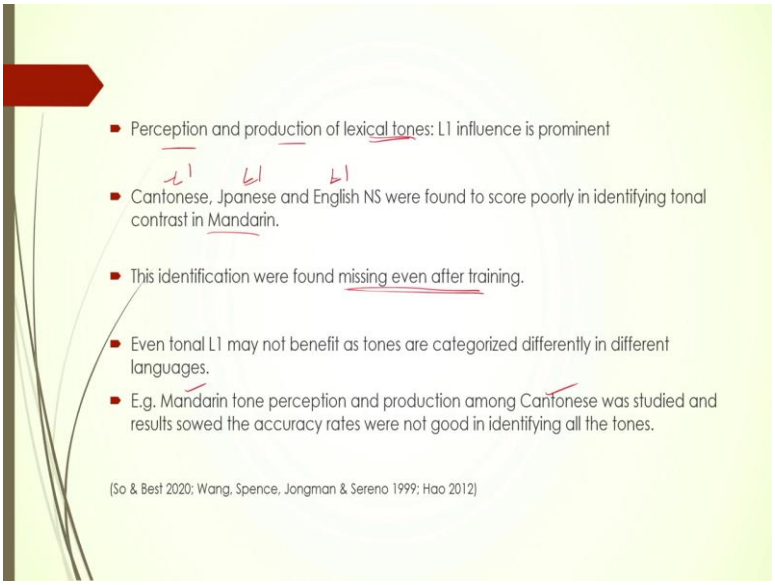

So, another area is the perception and production of lexical tones of heavily researched area. Here also, we find a significant amount of influence of the L1 on the L2. So, studies have been conducted on Cantonese, Japanese and English native speakers are found to score poorly in identifying the tonal contrast in Mandarin. Mandarin Chinese is a tonal language.

So, tonal, another thing to keep in mind in terms of tone is that even though many languages can be tonal. So, you can have you can speak L1 tonal language and learn L2 which is also tonal, but that does not make life always easy because the tonal contrast may be different.

Each language has their own tonal maps so to say and if there is tonal and all tonal difference, then of course the problems are even more severe. So, this identification were found even missing even after training. So, even after these Cantonese, Cantonese is also a Chinese language which means this is they also have tone, English does not have tone Japanese. So, these people, they found they were not able to correctly identify the tone contrast in Mandarin even after they were given training.

So, before training, after training did not have much difference; even tonal L1 may not benefit as tones are categorized differently in different languages, as I just mentioned. So, for example, Mandarin tone perception and production among Cantonese was studied and results showed that accuracy rates were not good in identifying all the tones.

In some tones, there was better performance. In some of the other tones, there are 4 different tones. So, there are in some tones, they were performing better. In some other tones, they were not. So, if there is a contrast in the tonal pattern in L1 and L2, then there will be difficulties.

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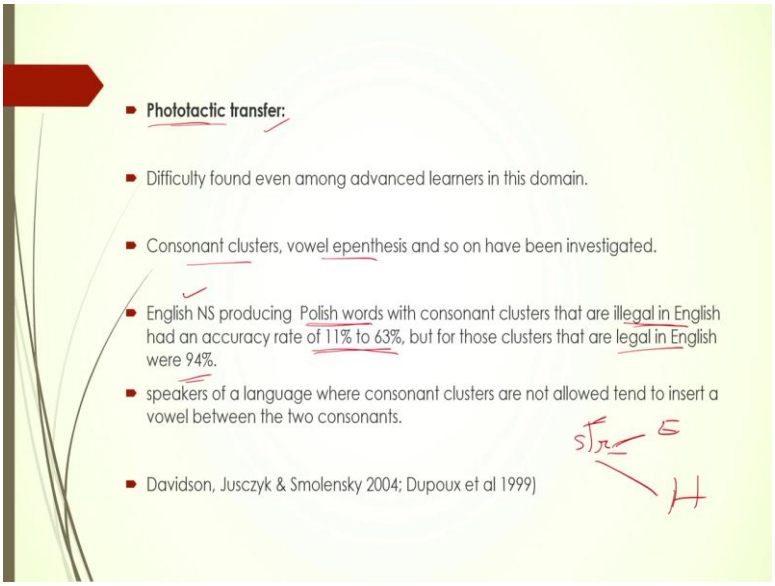

Then we have the domain called phonotactic properties, how phonotactic properties from L1 gets transferred to your L2. So, difficulty was found even among advanced learners in this domain. So consonant clusters, vowel epenthesis and so have been investigated within these domains; so these are part of phonotactics in any language.

So, English native speakers producing Polish words, Polish and Czech words have very different consonant clusters as opposed to any other language that we know, so very difficult, very different kind of consonant cluster. Now, this study looked at English native speakers who were speaking in Polish with consonant clusters that are illegal in English. So, Polish language has very different consonant clusters that just said. So, some of those clusters are illegal in English, meaning they do not exist in English.

So, those consonant clusters are Polish that are not possible in English, they found accuracy rate between 11 percent to 63 percent depending on various, so as low as 11 percent has also been reported. But for those clusters that are legal in English, the accuracy was 94 percent. So, the consonant clusters in your language that are possible. For example, this is a consonant cluster that is possible in English and this is also possible in Hindi right.

If we have to identify a Hindi speaker has to identify a cluster like this in English, the accuracy rate will be higher. However, if you were made to identify a consonant cluster that does not exist in your language, accuracy rate falls. So, this is what the finding primarily talks about.

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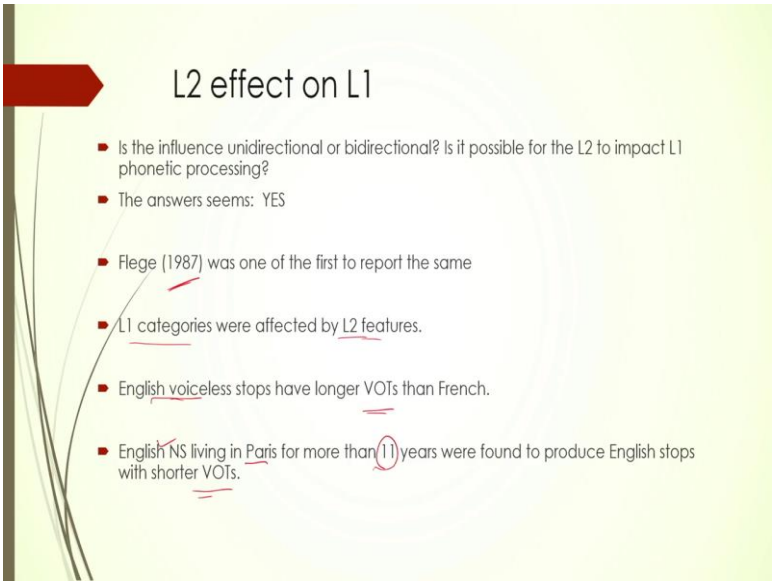

Now, we will go to the L2 effect on L1. So, far we are looking at some of the major domains of L1 to L2 transfer in terms of phonological properties of languages. Now, let us look at L2 effect on L1. The transfer can also happen the other way around.

So, even though the typically what happens is if for L1 is stronger or dominant language, chances are very high that you will see an L1 to L2 transfer more often. However, if L2 becomes more dominant and stronger, then the other opposite side of influence is also possible. So, one of the first studies to report this the opposite traffic was Flege in 1987. So, they had found out that L1 categories were affected by L2 features.

So, one of the features that we are looking at is English voiceless stops. Now, English voiceless stops have a longer VOT than French. English voiceless stops have a longer voice onset time compared to French.

So, French has a shorter VOT English as a longer VOT for the same voiceless stops. Now therefore, they looked at English native speakers living in Paris for more than 11 years and they were found to produce English stops with shorter VOT because they have been living in Paris for 11 years and they have been speaking French.

So, probably their French have has become dominant language and as a result of which the shorter VOT for voiceless stops in French has affected their VOT of the same stops in English language. So, now they are producing English voiceless stops with shorter VOT even though native speakers of English will have a longer VOT.

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Similarly, another study looked at American students studying in Korean immersion program. So, English native speakers studying in Korean immersion program, they found a general lowering of F1 and F2 values of all English vowels due to lower similar values in Korean.

So, Korean vowels, the similar corresponding vowels between English and Korean have different F1 and F2 values, frequency F1 and F2 values in terms of frequency in these 2 languages. So, English vowels have a higher value compared to Korean. So, Korean has

a slightly lower value, as a result of which after these participants had been studying in that Korean immersion program for some time, their vowels in English also had a lower F1 and F2 value. Similarly, another study looked at Russian monolinguals, compared Russian monolinguals with Russian-English bilinguals living in the USA.

So, again Russian is L1, L2 is English, but they have been living in USA for many years. So, in Russian what happens in this language something called neutralization happens. What is neutralization? It is the devoicing of the word final consonant. So, in case of this kind of a word, 'kod' code becomes 'kot', the d transfers to t sound. So, this contrast involves stops and fricatives both in Russian, but this is this does not happen in English. This is common in Russian, but not in English.

The bilinguals in this case showed less tendency towards devoicing in a reading. So, the reading test and bilingual in Russian speakers who were living in US for a long time showed less tendency towards this neutralization process as opposed to Russian monolinguals. Meaning something that is very common in Russian language which is part of Russian phonetic system, phonological system was found to be affected by the L2 property in this particular domain.

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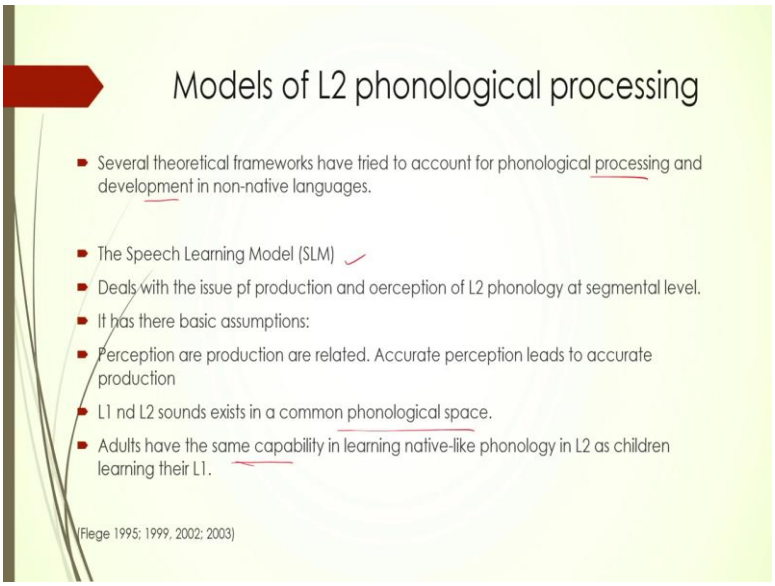

So, based on so these are some of the studies, these are some of the domains of course, this is again a must stress this that this is an area in itself, phonological processing in bilingual phonological processing is a rather broad area of research. We have now looked

at only some of the major properties, major domains of research with the basic findings in all of these.

So, we will conclude this module with a couple of models that have tried to make sense of what is happening. There are many models in this domain, but we will look at 2 of the most more well-known ones. So, theoretical very several theoretical frameworks have tried to account for the phonological processing as well as development of in the non-native language.

What happens when a person learns a second language? What are the phonological changes and the nature of that change and how those changes develop over a period of time? These are the areas that have been looked at. So, one model trying to look at it is the SLM model, Speech Learning Model. This model deals with the issue of production and perception of L2 phonology at segmental level.

And it has three basic assumptions, that one is perception and production are related, they are not separate processes, they are related processes. So, if perception is accurate then production will also be accurate. So, this is a 2 way traffic. So, perception and production are connected, production is dependent on perception to a large extent, as per as this model is concerned.

L1 and L2 sounds exist in a common phonological space, so both L1 and L2 sounds are part of a larger common phonological space which is something that many other models have also talked about in terms of the models we looked at BIMOLA and other models.

So, they talk about a common phonological space which has subset of L1 phonology and L2 phonology. Adults have the same capability or in learning native like phonology in L2 as children learning they are L1. These are the basic presuppositions of the models called speech learning model of s or SLM, this was given by Flage in 1995 and has been updated many times.

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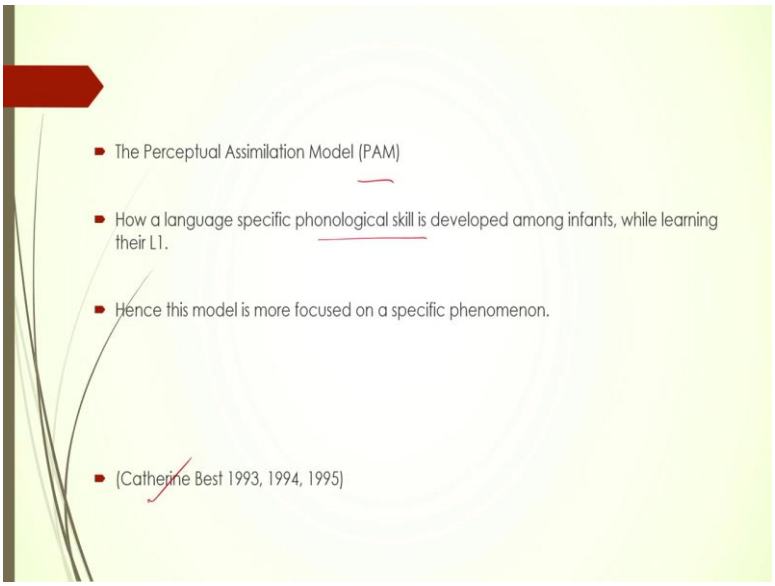

So, this is one of the models and the other model is what is called the perceptual assimilation model or PAM. This was proposed by Catherine Best. Now, this model is slightly different, the focus is different in this model. This is a this model looks at how a language specific phonological skill is developed.

So, this particular model is has a much focused narrower focus on in terms of phonological development in infant. So, development of specific phonological skills, language specific phonological skills and how it develops in infants, this is while they learn their L1.

So, while a child a little a small child from their birth till a couple of few years of their age, how the phonological skill set develops. Phonological skill set specific to the particular language that they are learning, how that development happens is what the model looks at. So, this is slightly different from SLM and a lot of studies actually take into account both SLM and PLM together to understand the way the phonological development in takes place in L1 and L2 and how the interaction typically happens.

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So, this is where we will conclude. Other facets of bilingual language processing we will discuss in the next module; we will discuss in terms of word level processing and sentence level processing. So, this is where we conclude module 5.

Thank you.