Psychology Of Bilingualism And Multilingualism
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Week - 02
Lecture – 08

Hello and welcome to the course introduction to the psychology of bilingualism and multilingualism. I am Dr. Ark Verma from the department of colonial sciences at IIT Kanpur. This is the third lecture of the second week. You might remember that we were talking about the ability to perceive you know phonemes and phonemic contrasts in the native language and also in bilingual scenarios. In today's lecture or in today's and you know in upcoming lectures, I am going to talk a little bit more about how do infants build upon this ability to perceive phonemic contrasts to basically start you know developing to basically start developing this ability to perceive words from a continuous stream of speech.

So you might have noticed that we typically you know when we are talking to children or say for example, let us even not talk about children here, but say for example, if you are if you are listening to speech, if you are watching a movie, listening to a song, songs are relatively easier, but if you are listening to a speech rather monotonous one in a language that you do not know, it sometimes becomes very difficult to actually keep the words apart from each other. Sometimes people would speak so fast and if you do not know the language, it becomes very very difficult for speakers, for listeners of a different language to be able to segment the continuous stream of speech into words. The word boundaries are not clear. There are typically no you know clues as to how you know where is one word ending and the other word starting.

So that is something which is very very interesting. Also if you pay attention to how individuals speak, when we are speaking fluently, we are speak in a continuous stream of speech and unless you are already aware of these words, unless you can start picking up oh this word came here and that word came there, you will not be able to sort of you know segment this stream of speech. It is pretty much the case of you know it is pretty much the case also with you know when we are talking to infants. While unless we are taking a special effort in talking to children in the way that we are slowing down our speech, we are highlighting certain word endings and word beginnings, we are you know pointing out and sort of you know helping them out understand, maybe slowing down the movements of the mouth and so on. It is in that sense equally difficult for infants, probably much more difficult for infants to be able to segment the continuous stream of speech into words.

This particular problem which concerns the segmentation of speech into segmentation of continuous speech into words is referred to as the segmentation problem. Today I am going to talk to you about the segmentation problem. As infants you know you can see and as I just mentioned, it is the problem of segmentation is even more challenging for the infants because they have only just started to pick up the basic sounds of you know the language that they are seeking to learn. And although the sounds are the building blocks of these words, they overlap a lot. They you know they mix with each other a lot.

There is a lot of co-articulation that goes into when they you know that goes into speaking which the infants are probably not you know very easily being able to make out. So infants also later have to start connecting words to meanings. So for example, it is not merely that they can start seeing oh these are the word boundaries, they actually have to connect these words to meanings for their journey you know for this activity to be actually useful in their journey of acquiring that language. So not only infants have to segment this continuous effluent stream of speech into words, they also have to sort of attach these specific words let us say that they are able to segment to meanings because that is how the learning of the language is actually commence. Now since there are no obvious clues for infants to tackle the speech segmentation problem, the researchers have wondered as to what kinds of techniques, what kind of strategies they might be using and what kind of strategies might actually be helpful for the children which help them to segment this continuous stream of speech.

This consideration becomes even more fascinating. If you you know look at the fact that around 12 months of age or so children have a vocabulary of about 50 to 100 words, but around 18 months of age they experience what is called a word spurt or a vocabulary spurt differently in different books you will find it and from then onwards their vocabulary starts expanding almost exponentially. So while we have been pondering about that you know segmenting speech is a very difficult problem and so on and so forth, it is very fascinating that children actually crack this problem by around 12 to 18 months of age within this period somewhere they get the hack of how to you know segment this stream of speech into words and also attach those words to meanings okay. So this is basically what is going to be the focus of the next couple of lectures. So what are the candidate abilities you know how are people actually do, how are infants actually doing it because that is our you know subject of consideration.

Now researchers have actually proposed that infants are able to exploit the statistical properties of the speech input more specifically the regularity and patterns of combination of speech sounds into words to solve the segmentation problem. Now remember if you remember the you know the diagram that I showed the figure you know Kulls chronology of speech perception you will see that around 5.5 to 6 months of age is

where they started paying more attention to specific combination of speech sounds you know the phonotactics. So maybe around this time they are sort of paying and they have to pay more attention to these phonotactic abilities in order to start segmenting speech. Let us look at this in more detail.

So Jusczyk and Aslin in 1995 have tried to find out the age at which these infants start recognizing the sound patterns of words in corrected speech. What did they do? They familiarized a group of 7.5 month old infants from American English homes with two monosyllabic words by presenting them repeatedly for some time. So it could be any monosyllabic word Pat, Bat, Mat, Hat anything and they basically repeated these words for a you know for a given span of time until they were familiarized. Afterwards what they did was they tested these infants by presenting four passages each consisting of six sentences.

Two of these passages contained six repetitions of the words they were previously familiarized with and two passages contained six repetitions of two novel words that they had not been familiarized with. Now what would you predict? The authors predicted that if the infants were actually noticing the similarity between the words that they had learned during familiarization phase and the words that are presented embedded in passages now in the test phase, there would be a difference in listening times between these four passages. The two passages that contain familiar words we will listen to much more than the two passages that contain repetitions of novel words. Indeed, that is exactly what they find. They find that the listening times for passages containing the familiar words was significantly longer than the listening times for passages containing novel words.

This led to the conclusion that around 7.5 month old you know 7.5 month old infants can actually isolate words from fluent speech at least the ones that they have actually heard in isolation or have been familiarized with. Now interestingly the same ability could not be demonstrated for 6 month old infants using the same protocol in the same experiment suggesting that this ability to isolate words from speech develops somewhere between 6 to 7. 5 months of age. This is a decent demonstration, but you could say that in the test phase of the previous experiment participants or infants were able to hear these words in isolated you know in isolation which is not really the case in you know natural scenarios. In natural scenarios typically children are constantly hearing words in embedded speech you know words embedded in fluent stream of speech. So Jusczyk and Aslin were also sort of curious and what they did was they performed a very similar experiment this time more closely mimicking the natural you know segmentation scenarios and what they did here was that they presented these group of 7.5 month olds with words embedded in passages and in the test phase they presented a list of words 4 lists of words 2 lists

containing one of the 2 words that had been occurring in the passages and 2 consisting of repetitions of either of the 2 novel words. Again you could see here that infants listen to the words that they were familiarized with much more than they listen to the words that they were not familiar with basically telling us that either way children by the age of

7.5 month of age are capable of isolating words from speech and they are sort of able to recognize what are the familiar words in any given discourse. But how are they doing it you know what is it that is helping them do this we have established now that by around 7.5 months of age they are capable of isolating you know words from speech but how are they doing it? Saffran and colleagues tried to answer this question you know they proposed a mechanism of statistical learning to explain the ability of these 7.5 month olds. How did they do this? They tested this idea by exposing a group of 8 month olds from an American English linguistic setup to 2 minutes of fluent synthesized speech nonsensical speech which was devoid of any other clues any familiarity any meaning relations and so on.

This speech stream consisted of 4 trisyllabic nonsense words like pa, b, ku, ti, bu, do, go, la, tu and do, ra, pi. So you can see pa, b, ku, 3 syllables ti, bu, do, 3 syllables go, la, tu and do, ra, pi. So there are 4 of these words which are trisyllabic words and the stream did not contain any pauses any stress differences any rhythm difference anything like that. So that only the statistical probability of that you know pa is followed by b is followed by ku is what they have. The only way therefore these infants could isolate these words would be these transitional probabilities that I mentioned.

So for example, b follows pa with 100% probability, ku follows b with 100% probability and so on and so forth. Now what did they do during the test phase? During the test phase the infants were presented with repetitions of 2 out of the 4 words that they were presented in training and with repetitions of 2 new 3 syllable words. So 2 words 2 3 syllable words were from the test phase from the familiarization phase and 2 new trisyllabic words from the you know were something that was not presented earlier. Now while infants might have encountered these syllables both in the familiarization and test phases and this again these 2 new trisyllabic words that they have sort of concocted are very interesting because they have been created by combining the first you know the final syllable of one of the earlier words with the first 2 syllables of the following words. Say for example, in pa b ku, ti bu do and gola pi what they are doing is say for example, dora pi the pi from they are combining it with gola to the go and la from this previous word.

So it basically creates words like tu da ro and pi gola which are basically again these syllables might have been heard earlier but they have not been heard with equal probability. When they hear this pa b ku, ti bu do, pa b ku, ti bu do, gola to and dora pi they are actually hearing these coming together more frequently with more you know

higher probability than what they have heard of tu da ro coming together or pi gola coming together. So the difference is while the syllables are also the same the transitional probabilities are different. Transitional probability basically meaning with what probability a particular syllable follows the other. So if now in this scenario infants would be able to distinguish between the familiarization words and the test words it would indicate that they are able to decipher the transitional probabilities of the combination of these syllables from the speech stream.

And indeed this is what was found the infants could actually you know recognize the words from the familiarization phase even though that even though they contain very similar syllables to words in the test ways but things that occurred more frequently together with higher probability were recognized better. So this sort of tells us Saffran would say Saffran and colleagues would say that infants are actually paying a lot of attention to the transitional probabilities of these syllables occurring one after the other. Saffran further wanted to strengthen these findings and what they did was they demonstrated that infants are not only able to sort of isolate these combination of phonemes these combination of syllables together but they are actually treating the output of this statistical learning process as actual potential words. So what did they do? In a study they actually familiarized a group of 8 month old infants with 4, 3 syllabic nonsense words just like pabiku, tibudo, gulapi and so on and they presented them in either a sentence context of what a nice pabiku, what a nice tudaro and so on and so forth or in a nonsense context so zi fike nipi pabiku and so on. So where word in the first sentence context you can see it is a meaningful context the word is being used as an actual object name or something like that whereas in the second one in a nonsense context it is just a stream of speech with all of these syllables coming together.

Now Saffran proposed that these if these infants were actually treating these you know trisyllabic concoctions as actual words they would recognize them better in the sentence context rather than in the nonsensical context and again this is exactly what was found the infants listened longer to these syllables when they were presented in the sentence context rather than when they were presented in the nonsensical context. So basically what we are seeing is if you you know put together the lectures from this week together what we are seeing is a chronological development of how children are learning to perceive speech. They initially learn to perceive the differences between phonemes and then they started putting together the sequences of phonemes together and here you are seeing that they are being able to use that ability to isolate words from a continuous stream of speech. Saffran studies indeed demonstrate the fact that infants are sensitive to the sequential probabilities of speech segments. Here we are talking about syllable size frames but similar study a similar you know aspects have been demonstrated say for example the study of chambers and colleagues that infants are also sensitive to phoneme

to the probability of occurrence of separate phonemes as well.

So infants are basically picking up on the statistical regularities in the input at the level of phonemes at the level of syllables probably at the level of words and so on as well. But these two were sort of you know artificial scenarios so Saffran studies are very interesting and they very neatly demonstrate that children are paying attention to you know these scenarios the statistical distribution and the transitional probabilities but again these were artificial speeches and so on and so people were curious as to what will happen in real language scenarios you know when we are talking presenting them actual language input. So Zusik and colleagues in 1993 they sort of tried to address this and they presented American and Dutch 9 month old infants with a series of Dutch and English word lists. Interestingly each list contained words that confirmed with the phonotactic rules of one language but not the other. Say for example an English word list obviously we chosen such that it would follow the conventions or transitional probabilities of English but not of Dutch and a Dutch word list was constructed such that it would follow the phonotactic constraints of Dutch but not English and they sort of asked these children to sort of you know perform the similar scenario and the results actually showed that American infants listened significantly longer to English words whereas and less longer to Dutch word list whereas the Dutch infants obviously listened much longer to Dutch words than English words.

So basically what we are seeing is that the same sort of happens the same pattern of picking up transitional probabilities happens in real language scenarios real word lists as well and interestingly if you note that children are sort of picking up the transitional probabilities specific to their language and not more generally as was happening in the case of perceiving phonemic contrasts. In a different study with Catalan Spanish 10 month olds Sebastian, Galles and Bosch provided evidence for the fact that growing up as bilinguals actually does not delay so does not significantly delay the individual's acquisition of phonotactic development okay. So what did they do in one experiment they presented 10 month old infants growing up in either Catalan speaking or Spanish speaking monolingual families with list of non-words all having a CVCC structure. Now CVCC is basically consonant verbal consonant consonant and basically what happens is that in Catalan word endings with CC clusters are actually legitimate they are legal whereas in Spanish it does not really happen at all. So these CVCC structures are actually valid for Catalan speaking individuals but not for Spanish speaking individuals.

Also interestingly what they did was that half of the list presented to both Catalan and Spanish infants consisted of non-words with legal Catalan ending clusters like BERT and CUSC and the other half with illegal Catalan end clusters like CATER and DATL. Note that while half of them are actually legal and acceptable in Catalan so BERT and

CUSC are legal and acceptable in Catalan whereas CATER and DATL are not. All four of these are not legal for Spanish individuals because in Spanish the word endings do not end with the CC and you know two consonants together. The results actually showed that around 10 month old Catalan infants could actually discriminate between legal and illegal Catalan end clusters as indexed in longer listening times to list containing legal non-words than to those containing illegal non-words. So Catalan speaking individuals are being able to make this distinction between the two types of CC clusters that are you know being found and hence they are demonstrating the sensitivity to the phonotactic constraints of Catalan.

For Spanish speaking infants neither of this makes sense so they obviously do not show any difference between whether the cluster is legal or illegal because they are both illegal for the Spanish individuals. So to establish the same in the bilingual setting the authors replicated the same experiment with Catalan Spanish bilingual to be infants you know simultaneous bilinguals who had been exposed to same to both these languages since birth. Now here they did they introduced a very interesting quirk. Two types of groups were tested one group was Catalan dominant so their exposure to Catalan was 60 percent Spanish was 40 percent and the other group was Spanish dominant whereas their exposure to Spanish were 60 percent and Catalan was 40 percent. Now in this scenario three kinds of outcomes could happen what are those if mere just exposure to you know Catalan and Spanish you know leads to phonotactic sensitivity then both groups of monolinguals should behave as their Catalan monolingual peers basically saying that because Catalan Spanish and Spanish Catalan both groups of bilinguals have some knowledge of Catalan they should actually behave like Catalan monolingual peers and be able to distinguish between legal and non-legal end clusters.

However, if the amount of exposure matters so how much of Catalan they have been getting if that matters then you could say that the largest effect would be found in Catalan monolinguals then in Catalan dominant bilinguals and then in Spanish dominant bilinguals. A third thing could happen whereas you could say that just if just language dominance is alright if just that language dominance is sort of you know sufficient then Catalan dominant bilinguals would also behave much similar to you know your Catalan speaking monolinguals and this is what these individuals set out to test. What did the results show? The results actually supported the language dominance hypothesis basically showing that the effects were equally large for Catalan monolingual and Catalan Spanish bilingual infants. What does this tell us? It tells us that for 10 month old monolingual Catalan infants and Catalan dominant infants they had both developed the phonotactic sensitivity for Catalan although the latter were yet to develop the same for the non-dominant or language or Spanish. If they had developed that for Spanish as well then maybe they would sort of get a bit confused and start rejecting both of them but

they had developed it for Catalan not so much for Spanish so far.

So language dominance is a very interesting factor language dominance is a very important factor in how children are developing and gaining these phonotactic constraints. So to summarize the combined results from these studies indicate that infants indeed are capable of recognizing the recurring syllable sequences in the speech input you know the statistical regularities in the speech input. The underlying mechanism as Saffran has very well demonstrated is very similar to a statistical learning mechanism more like a general statistical learning mechanism which is sensitive to the sequential or transitional probabilities of how syllables or phonemes occur one after the other even in the absence of any kinds of prosodic cues you know rhythm, tempo, stress and so on and so forth. And it helps in the segmentation and this is what they are using to you know segment the continuous stream of speech. This ability is supposed to you know help these infants to bootstrap the learning of words, bootstrap the acquisition of vocabulary in infants and it starts very early from around 1.

5 from around 7.5 to 8 months onwards. So this is one of the candidate abilities that we you know we are talking about is you know very very relevant to segmentation of speech. Finally, the third part which sort of you can conclude from this is that you know the performance of Catalan dominant and Catalan monolingual infants were very very similar and that actually could be taken to you know conclude that growing up as a bilingual does not necessarily delay the acquisition of these you know phonotactics in Catalan or in you know in Catalan or in Spanish because what they are doing is they are still being able to pick up the phonotactic constraints of that second language, alright. So that is all that I wanted to share in this lecture. I will meet you in another one where we will be talking about an alternative way of picking up you know or tackling the word segment, language segmentation problem, alright. Thank you so much. .