

**Psychology Of Bilingualism And Multilingualism**  
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**Week - 02**  
**Lecture – 06**

Hello and welcome to the course introduction to The Psychology Of Bilingualism And Multilingualism. I am Dr. Ark Verma from the Department Of Cognitive Sciences at IIT Kanpur. Welcome to the second week of this course. I ended the last week when I taught you about the paradigms and the methodologies used for investigating language acquisition in children and we talked about a bunch of paradigms including the HAS paradigm, the head turn procedure, the listening procedure and so on.

In this week we will basically look at some of the experiments that have investigated how various aspects of language acquisition are actually achieved by children using these very paradigms that I talked to you about in the previous class. Today we will start talking about language acquisition in bi and multilinguals. So let us start. Now as mentioned in the previous lecture various different in engineers paradigms have been developed to track the development of language acquisition amongst infants.

These paradigms have actually boosted the research that has been conducted into the infants ability to perceive and understand language and have consequently informed the researchers of how the same develops through chronologically you know spaced steps. Researchers have used these paradigms to investigate language acquisition or aspects of language acquisition in infants as young as 1 or 2 days old from you know to 1 month old to 3 to 4-year-old children. Let us look at some of these examples. Now one of the very interesting studies was conducted by Eimas and colleagues in 1971 when they presented 1 and 4 month old infants with the number of machine synthesized instances of the sounds pa and ba which are as you know bilabial plosives. So bilabial plosives is basically a sound which is created by joining the you know the upper and the lower lip constructing the flow of air and then releasing it.

So for example, ba and pa are bilabial plosives. However, they are different from each other in one very interesting aspect. This aspect is called the voice onset time. What is voice onset time? Voice onset time is basically the time that elapses between the release of the air and the you know release of the sound and the vibration of the vocal cords. If you see when you speak ba or pa in one of these instances for example in pa there will be a voice and there will be a vibration of the vocal cords here.

So research has shown that English speakers identify can identify bilabial plosives of

VOT values plus 25 milliseconds as per and above plus above 25 milliseconds as per. Basically saying and now one of the things that we need to remember is that the VOT values can be in negative, it can be 0 and it can be positive as well. So the VOT value basically means that the vibration happens starts happening even before the sound is uttered. 0 basically means that the vibrations of the vocal cords start happening simultaneously when the sound is occurred and plus you know 5, 10, 25 milliseconds basically means that the vibration happens after x seconds after x milliseconds that the sound is uttered. So in the current study what happened was that infants from each age group 1 month and 4 month olds were divided into 3 groups.

One group was familiarized with plus 20 millisecond VOT stimuli and tested with the plus 40 millisecond VOT stimuli. Now note that both of these are basically you know positive VOT values basically vibration is happening after the sound has been occurred. But interestingly they fall at opposite ends of the ba and pa continuum. We saw that values below plus 25 milliseconds are basically referred to as ba and values after plus 25 milliseconds are referred to as pa. So basically what is happening is that while they are being familiarized with pa they are being tested with values that occur in the pa spectrum.

Similarly the second subgroup was habituated and tested with similes of either 20 milliseconds and 0 milliseconds or with 40 milliseconds and 60 milliseconds VOTs. Basically here you can see that both these pairs of stimuli lie on the same side of the ba and pa spectrum. So for example 20 and 0 both lie within the pa spectrum and 40 and 60 both lie within the pa spectrum. Now the idea here is to basically check whether these infants at 1 month age and 4 month age can actually distinguish between the two sounds because the only difference between ba and pa is the VOT values. So the idea is that in these cases if you see the three groups you know in these cases how are the infants going to be able to distinguish between these sounds.

The third subgroup was basically used as a control group and was presented with the exact same stimuli where in the test phase as well as the familiarization phase. Now what would you expect to be the performance of these three subgroups? Do you think that all these three subgroups basically the you know the infants who are presented with ba and pa in different spectrums or both ba's or both pa's or let us say the same ba and pa in the test and familiarization phase, how will they fare? Interestingly if they are able to distinguish between let us say for the first subgroup if they are able to distinguish between the ba and pa because they are being you know presented with different sounds in the familiarization phase and the test phase should tell us that these infants are capable of distinguish between distinguishing between these two categories of phonemes. Now Eimas and colleagues actually found that only the first subgroup demonstrated a release

from habituation using the HAS paradigm showing that they could actually recognize the phonemes that were presented across the VOT boundary. Remember the first subgroup was presented with you know instances of these phonemes with plus 20 and plus 40 where plus 20 lies in the ba spectrum whereas plus 40 lies in the pa spectrum. The second subgroup were either presented with 0 and 20 or with 40 and 60.

So, basically the sounds are falling within the same spectrum and therefore they will be harder to distinguish and infants are not going to be able to distinguish between them. So here it is not surprising that only the infants from the first subgroup who were tested on different categories of sounds ba and pa could actually experience release from habituation basically that they notice the difference between these two sounds. Now this capability to perceive the difference between these two phonemes ba and pa actually is referred to as categorical perception. This is the fundamental ability in speech perception because this is the ability that determines how are infants going to perceive different categories of phonemes of their given language. For example, English has around 44 phonemes and these phonemes are the basic sound categories of English.

So the entire English language can be sort of you know drawn back to these 44 distinct categories of sounds. So obviously categorical perception is one of the major and fundamental abilities that are required in order for an infant to you know start perceiving speech in special ways. Following this the authors concluded that much like adults, infants are also capable of perceiving linguistically meaningful differences between these speech sounds that is that they can perceive these different phonemes which are the basic categories of sounds in any given language. Now several studies followed the work of Eimas and colleagues and they actually demonstrated that indeed infants have the ability to perceive contrast between phonemes and you know different speech sound categories. For example, some research also shows that infants are capable of distinguishing between not only bilabial process like ba and pa but also fricatives and other kinds of sounds.

Now given that infants as young as one month old were found to be able to distinguish between these categories of speech sounds, researchers have suggested that the ability of categorical perception is actually an innate ability. It is not really possible, it is less plausible that this is something that infants have picked up after their birth. So it must be noted that different languages have different phoneme categories and given that this ability is innate, one should assume that infants would be sensitive to phoneme categories irrespective of the language input. Now the idea is that give see you could try and understand this in this way that infants are born in you know different kinds of language speaking families but if they are born with a particular innate ability that basically means that innate ability would be language would be regardless of the

specifics of any given language. Because if we say that an infant is born with only the ability to perceive speech in let us say English or Hindi or any other language then we are basically you know going to the erroneous assumption that innately it is decided which language an individual can learn or cannot learn but that obviously as we know is not the case.

So basically what we are saying is that while the ability of categorical perception is innate it must be more like a language general ability. Indeed in a cross linguistic study for 11 languages Lisker and Abramson actually were able to demonstrate that although different languages slice up the VOT continuum differently to carve out different categories of speech, infants may be differentially sensitive to the phoneme categories of different languages. So researchers have shown that while the ability to perceive different phoneme categories is innate infants who are under 7 months of age are sensitive to phonemic contrast not only for their own native language which was Spanish in their case but also for phonemic contrast that occur in other languages as well. So basically what we are seeing here is that infants have this innate ability to categorize you know speech into different phoneme categories and this ability of categorical perception is available across languages at least in the early days it is available for not only the native language but other languages as well. Now if you look at this data more closely if you look at this data you know in more detail the data from these experiments can be taken to suggest that infants do not learn to perceive all of the phonemic contrasts that occur in all natural languages and the same is in some sense a function of the type of language exposure that the children have received.

So there is a lot of research which basically says that while infants you know at a very early age are capable of perceiving phonemic contrast across several languages it is not that they are capable of learning or they are capable of distinguishing the phonemic contrast of all known languages there are more than 7000-8000 languages the assumption is not that they are able to you know distinguish across all languages but in a lot of languages obviously also in a lot of languages additional to the native language or languages just similar to native language. So people have also noted that at the age of around 6.5 months it was not really sufficient to learn also all the phonemic contrasts of the native language as well. So what we are saying is while the ability of categorical perception you know is innate and it is in some sense relatively language general ability but this ability does not mean that at least that even for the native language everything has been learned you know they do know some of the or they are able to distinguish some of the phonemic contrasts of the native language but not all of the phonemic contrasts of the native language because for that they would need more experience and they would need more language input to be sort of trained to be able to make that distinction. Now this innateness you know of categorical perception has been the source

of a bit of a dispute amongst researchers and there are typically two lines there are two lines of argument here for example some scientists have proposed that categorical perception only applies to language and it is not a general property of auditory perception.

So the idea is that it is a specific capability of perceiving human languages and it is not the property of a general auditory perception capability also implying in the same vane that this is something that is unique to humans it is not something it is a unique speech perception capability that is unique to humans and is not shared by other species but a lot of literature actually suggests on the contrary and which brings me to the second you know point which is that a lot of you know researchers also opine that categorical perception is not really unique to the acquisition of language it is the proper it is the property of the general auditory you know perception system and is shared by a few other species as well for example you know the Japanese quail or the chinchillas and macaques even have this capability of being able to distinguish between phoneme categories and at very early ages. So the idea here is that if you sort of look at you know some of the arguments put forward by Chomsky and the other nativists while categorical perception is obviously innate because it happens very very early in the you know chronological time space but it is not something that is unique uniquely developed for learning language in humans it is probably a property of auditory perception you know auditory perceptual system that we share with other species as well and that is why this capability is also shared with you know other species as I mentioned the chinchillas the Japanese quail the macaques maybe you know some other animals as well. Now if you look at this discussion in a bit more detail you know different you know questions can be asked some of these questions have been summarized by De Groot in her book you know a handbook of bilingualism and multilingualism language in cognition and bilingualism multilinguals and you know some of these questions are for example to humans continue to perceive phonetic contrasts that are meaningful in some languages but not in the native language if not by when does this ability start declining by when does this ability to perceive phonetic contrasts and then other languages start to decline. The second question that can be asked is how long does it take for humans to develop the ability to perceive all the phonemic contrasts within the native language remember we were just saying that while infants do have the ability to perceive phonetic contrasts you know innately in their native language but as I said they at 6.5 months they cannot do everything so by when will they be able to you know perceive all the phonemic contrasts that are relevant to their native language what is the timeline when does that really happen.

Finally for bilingualism it is interesting to ask that does the learning of phonemic contrasts of the native language and the unlearning of the phonemic contrast of the non-

native language create differences between monolinguals and bilinguals because this is something that is supposed to happen and it has been shown and I will show you a figure you know going forward you know which is basically equals timeline of how individuals learn you can see here that around you know around 6 months of age children sort of you know use statistical learning etc to learn the you know language specific phonemic contrasts but if you see around 8 months or 9 months they you know they start or around 11 months actually they start experiencing a decline in the foreign language constant perception and vowel perception. So some of part of the answer is actually here that you know this is an ability that starts in a sort of a language general format but gradually becomes more and more language specific as the children are growing up. The idea is that they are picking up more and more information from their native language and because they are not finding use you know and because they are not finding use for this distinction capability across you know other languages that they may not be eventually exposed to this they start showing a decline in that capability. Now let us zoom in a little bit so for example as I showed you Kuhl in 2004 presents you know a tentative chronology of how children under you know how children acquire speech going from you know 0 to 5 and a half months you know where they are where they are capable of distinguishing between phonetic contrasts of all languages again with a star not all but most languages large number of languages and by the time of around 11 months they start experiencing this decline in perceiving the foreign language constant you know contrast and they start experiencing an increase in native language constant perception. So this is something that is very very interesting so I have already talked about this.

As I said this chronology highlights the fact that about around 9 months of age the ability to perceive specific you know sequences of sounds in the native language basically the phonotactics you know gradually starts to emerge. So while we are talking about you know perception of phonemes categorical perception there are also other abilities that are very very important and fundamental for infants to start picking up language one of which is this capability called phonotactics which basically refers to infants having this ability to understand the sequence of phonemes. Say for example if I am using the word mutter there are three phonemes here mutter and ra and if I am using the word say for example you know chatter, patter, mutter and so on basically what I am trying to say is that these sounds are happening in particular sequences. If an infant is exposed to a lot of Hindi they would eventually pick up these patterns they would eventually start picking up the patterns in which phonemes occur in a given language and this is something that you can you know you can go back and see that around 9 months of age they start recognizing language specific sound combinations. This ability called the phonotactical ability is also very very fundamental to children's perception of speech and it sort of eventually becomes one of the fundamental building blocks of how they eventually pick up words and attach meanings to words and so on.

We will talk about some of these issues in future lectures of this week. So researchers have noted that this decline in the ability to perceive non-native phonemic contrast is also not universal in the sense that the ability to perceive some non-native contrast may still be retained till later ages. So we saw that around 11 months of age you know the infant start experiencing a decline in perceiving non-native phonemic contrast but not everything is lost as well. Some aspects are still sort of you know retained and let us talk about them because Best and Mc Roberts actually you know present few accounts basically trying to explain that which of these abilities or which of the ability to perceive which of these contrasts will actually remain. So one account given by Burnham basically distinguishes between fragile and robust phonemic contrast where they say that fragile contrasts basically are you know non-salient and occur only in few languages of the world but robust phonemic contrasts are ones that are very salient and are found to occur across several languages.

Now you can see that these robust phonemic contrasts might be very useful for children as they go ahead which might be one of the reasons that they sort of these abilities still sort of remain because you know if the native language contains a phonemic contrast let us say ba or pa which is also you know common to maybe some other languages then they will still be able to you know they will still be able to perceive the distinctions between phonemes of these other languages which are similar or common to the native language. Alright this may not work in the case of say for example the differences between la and ra which are you know not there in Japanese but are present in you know in English for example. Now another account which was given by Tees and Werker in 1984 suggests that non-native phonemic contrasts that will be continued to be perceived if they are allophones any similar sounds of similar phonemes in the ambient language environment and are lost if that is not the case. Again something basically aligning that if the ability is useful to have is anyways going to be used in the native language phonemic distinctions then it is quite possible that some of these you know sounds that are also distinguished similarly in the native language similar distinctions will still remain in the repertoire of the children. Finally, Eimas and colleagues offer what is referred to as the perceptual assimilation model which basically says that individuals infants basically are capable of assimilating the non-native phonemes with native phonemes.

So basically what happens is that while you may have native phonemic categories let us say ba and pa, ta and da and so on and so forth everything that is sort of similar may be assimilated in the in the same way. So for example, what individuals might do is that they might be able to assimilate the non-native phonemes and fuse them with the native phonemes which they perceive as most similar to these and therefore, they would still continue to make these distinctions and things that can do cannot be assimilated within

the native phonemic scheme will be lost. So if you see in summary all three of these you know accounts actually say that non-native contrasts which are relevant to the native language may still be retained and non-native contrast that are not relevant to the native language will obviously be lost if they will fade away. So in summary how do we sort of go ahead we can actually say that the ability of categorical perception is certainly innate and it is a fundamental ability of speech perception. Secondly that when infants sort of you know are born with this ability of categorical perception they gradually become better with age at perceiving the contrast of the native language while at the same time the ability of perceiving these contrast from the non-native language starts declining and although as we were just discussing this decline is not universal and not complete it basically depends upon which phonemic contrast from the non-native language are relevant to the native language and which are not.

So in this lecture we sort of saw you know we talked about one of the most fundamental abilities of you know human speech perception which is the ability to perceive phonological contrast and categorical perception in the scheme of speech perception which will be the fundamental building block of how infants learn to perceive speech make these distinctions between different sounds and eventually this will feed on to how they distinguish between words and so on. Thank you.