Psychology of Bilingualism and Multilingualism
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Week – 02
Lecture – 10

Hello and welcome to the final lecture of the second week of the course introduction to the psychology of bilingualism and multilingualism. As you know I am Dr. Ark Verma from the department of cognitive sciences at IIT Kanpur and we have been talking about different aspects of language acquisition in this week. In the previous lectures we saw how infants use the statistical and prosodic properties of the speech stream to segment the continuous speech stream into words. In today's lecture we will talk a little bit about how do infants move a step ahead and connect the words that they have isolated from the fluent speech along with meanings. Now one of the critical steps in this regard would be when infants start recognizing familiar words from a given speech stream.

So they should be able to sort of you know hear a strand of continuous speech and be able to recognize that oh I remember this word, I remember that word and so on and so forth. Obviously we are talking about one month, two month, five month old infants and they will not really respond in the way like adults do but the idea is that they should be able to you know notice the familiar words from a stream of unfamiliar words and so on. And once they sort of start gaining familiarity that is only when they will be able to start attaching meaning to these things. Now an interesting aspect here is that familiarity will actually develop not all at once but it will probably need to you know it will need to develop more gradually after more prolonged exposure or encounter with the same word form across different kinds of situations.

So for example, children hear a lot of different kinds of words when they are you know around different kinds of speakers whether it is their primary caregivers or other members of the family, visitors, relatives and so on and so forth. Now what you would notice is that at certain point of time they start recognizing and reacting to specific words or words that they know from the speech stream of these speakers. So how will that happen? It happens very gradually over a period of time when they have listened to that word across a variety of situations. More importantly this development of familiarity with words will also happen slightly later than the familiarity with sub-lexical forms such as phonemes and syllables has happened or let us say the knowledge of phonotactics of their given language has already been established. In the previous 4 lectures of this week you have seen that it is it takes some time for children to develop you know the knowledge of the phonemes of their language starting with categorical

perception at around you know at a very early age to learning of the you know native phonemic contrast and unlearning of the non-native phonemic contrast and so on and so forth.

So it is a journey that they are sort of started from the day of their birth and around a particular point in time in this chronology they would start recognizing words as oh this is a familiar word versus this is an unfamiliar or a new word. Now let us look at a study wherein authors actually examine the development of this ability to detect familiar words in both monolingual and bilingual children. So Vihmann and colleagues in 2007 took to examine this ability to recognize word forms by testing groups of English monolinguals English monolingual infants across 4 age groups 9, 10, 11 and 12 months of age. In addition one group of 11 month old English Welsh bilinguals were also tested. Now basically the test material or the stimuli for this study was taken from the child directed input which was produced by these infants families across and two sets of disyllabic English and Welsh words were detected from their speech stream.

In this stimulus set one set was referred to as the familiar word and it consisted of words adjust to be known by at least 35 percent of the infants and the other set was known as the unfamiliar set wherein most of these words were unknown to all the infants. So basically what they have done is that they have sample words out of the child directed input and given to these children from their families. Just a bit of a pause here that what is child directed input? Child directed input is basically how we talk to children in our homes and how mothers talk to children how teachers in you know teachers talk to children and so on. Child directed input has a peculiar characteristics in that the word boundaries are highlighted the words are slightly louder they are more like in a sing-song manner so that the children can start appreciating how these words are connected what are the phonemes and so on and so forth. So child directed input is very very critical and it is one of the you know it is basically tailor made for children to start appreciating or help them segment the speech stream into words basically it contains a lot of isolated words, lot of high-pitched words, words with clear word boundaries and so on.

So this is something that the children would be more familiar with already and what these experimenters did that they actually sampled known and unknown words from the child directed input was given to the children already by their families. Now the experiment consists of two part the first part was a behavioural study and in this behavioural study they basically used a version of the head turn procedure where two loudspeakers were mounted on the sides on you know either on the walls on either side of the participant and on each trial one stimulus from each of the word set was played from loudspeaker and across trials what happened was that the presentation side any left side or right side and the type of word familiar or unfamiliar was randomly chosen. Now the authors

actually expected that a difference in the looking time between familiar and unfamiliar word sets would indicate that the effect that due to the effect of prior familiarization of words in this in the natural setting would lead to the emergence of word form familiarity or word form recognition. Now remember this is because this is specifically because in this study there was no familiarization phase explicitly for the participants the familiar words were actually sampled from the child directed input and they were assumed to be known by these participants already. In the second part of the study what they did was that they measured ERP responses electrophysiological responses basically event related potentials which are just to sort of you know give you a brief idea event related potentials are electrical responses of the brain which happen in response to specific types of stimuli.

For you know for a better understanding of this you may you know just want to let us say Google electrophysiological responses EG and ERP and you will get some idea about this for our purposes you just need to remember that ERP's are actually you know electrical responses of the brain in response to specific kinds of stimuli and specific kinds of independent variable manipulations. Now coming back in the second part of the stimuli ERP's to the same stimulus words familiar versus unfamiliar were measured to see how this familiarity of word stimuli actually affects the responses from the brain. Now here all the similes were presented to the participants in a random order so familiar and unfamiliar were mixed and presented to the participants in a random order. In the ERP study of all the four English monolingual age groups only the 11 month old children actually showed a significant difference in the neural responses between the familiar and unfamiliar word conditions. Also among the bilingual infants also the 11 month old infants showed a reliable effect of familiarity in both languages and the size of this effect was similar to that of 11 month old monolinguals.

So you can see here that 11 months is pretty much the time where word familiarity is starting to emerge both in monolingual as well as in bilingual infants. That is exactly what these findings imply that word form recognition typically develops around 11 months of age and is not really noticeably delayed between monolingual and bilingual children. The authors hypothesize that the reason that this familiarity effect was not observed with older children of around 12 months of age was because in those children the you know the word form recognition has progressed to a higher stage and familiarity does not remain reason enough for the brain to respond to it. Similarly they are probably looking for more meaning and so on and familiarity does not remain the single you know critical factor to which the brain will respond. These hypothesis were corroborated by ERP data as well and in later similar studies also.

Now zooming a little bit more in detail a similar study was conducted by Conboy and Mills who examined the brain responses of bilingual Spanish English infants to different

types of spoken words. However these two studies the Vihmann and colleagues study and Conboy and Mills study differed in several critical aspects. Now Conboy and Mills were actually interested in teasing apart the roles of language experience and brain maturation in the neural responses to familiar and unfamiliar words whereas the idea was very different in the earlier study that we just finished. Now Conboy and Mills argued that bilingual children actually offered a very interesting opportunity to contrast the roles of two factors in word learning of these two factors in word learning because typically bilinguals will have been exposed to their two you know language in an uneven manner. Typically if you see you know in families where children are you know raised in a simultaneous bilingual environment from birth they still sort of get the input of one of these languages more than the input of another languages and that basically leads to one of these languages becoming a dominant language and the other language becoming a non dominant or a weaker language.

So, typically what happens is that given that these bilinguals are going to be exposed to their two languages unevenly one language will inevitably become the dominant language and the other language will become will inevitably become a weaker language. So, what Conboy and Mills were actually trying to do is they are trying to look at the effect of dominant versus weaker language as well as the difference in the maturational state of the brain because it is the same brain that is housing both the languages. So, the idea behind this study is that they want to distinguish the effects of language dominance and brain maturational state basically looking at how these two variables interact in you know bringing out the neural responses of the brain to familiar and unfamiliar words. A similar study to Wehmann and colleagues study was conducted by Conboy and Mills who examined the brain responses of Spanish and English bilinguals to different types of spoken words. However, these two studies differed in a couple of critical aspects whereas, Wehmann and colleagues were actually more after looking at the effects of familiarity and how the effects of familiarity sort of you know influence word form recognition.

Conboy and Mills were more interested in teasing apart the effects of you know language experience versus brain maturation in the neural responses to familiar and unfamiliar words. Now, what they argue is that bilingual children offer a very interesting opportunity to contrast the roles of these two variables in word learning because typically bilingual children are exposed to their two languages in an uneven manner. You know in any household where a bilingual child is being you know exposed to two languages at once typically what would happen is that one of the language input will be slightly higher and the other language input will be typically lower and that is what leads to one of these languages becoming a dominant language and the other language becoming a more weaker language. What Conboy and Mills were actually looking at is basically whether

the effect of you know a language being dominant or weaker, how does that impact the brain responses versus the maturational state of the brain because eventually both of these languages are housed in the same brain and the state of the maturation of the brain might also affect the neural responses that are generated in response to familiar and unfamiliar words. So, if the bilinguals brain responses to words similarly differ between their dominant and non-dominant languages or dominant and weaker languages it would be you know we would be able to deduce or conclude that amount of prior experience and not the state of maturation of the brain actually underlies the effects of word familiarity in these infants.
So, further the age group of participants in this experiment of Conboy and Mills was between 19 to 22 months. Remember we were dealing with 9, 10, 11 and 12 month old infants in Vihmann and colleagues study, but here we are dealing with slightly older children, children above 18 months of age and this basically implies that these group of infants are actually have already begun to link word and meanings together. There are couple of facts that could actually support this idea for example, 19 month old infants have already been shown to demonstrate what is known as the N400 effect. Now N400 is an ERP effect that arises when infants are or when infants or adults are capable of distinguishing whether a word is being uttered in a you know semantic congruent semantically congruent condition as well as semantically unconquerent condition. I could give you an example to explain say for example, if I am saying you know he spread the he spread the bread with warm butter versus if I am saying that if he spread the bread with warm socks if the infant or an adult hear warm socks obviously you know suddenly there is this N400 peak that is you know observed which tells us that the infant or adult has acknowledged the semantic incongruency that is you know being displayed here.

So, it basically is an index of whether and how well the infant or the adults are being able to semantically integrate whatever they are hearing. So, this is one you know way to support the idea that these 19 to 21 22 month old infants are already linking words to meanings. Secondly infants actually experience what is called the vocabulary spurt around 18 months of age and as I mentioned in a previous lecture that it is around 18 months of age where their vocabulary starts exponentially increasing which also basically tells us that these infants possess the ability to link word forms to meanings because otherwise they will not be able to have this rapid growth in their size of vocabulary. So, the present authors also slightly in difference to you know Vihmann and colleagues study actually developed an individuated set of stimuli for each of these children. They ensured that all the words from the known set are actually known to the each specific child and all the words from the unknown set are also unknown to each of these specific children.

So, these are some of the critical methodological differences between Vihmann and

colleagues study and Conboy and Mills study. So, also here the participants could be split into two different groups by their total conceptual vocabulary size which basically tells us how many words does this child typically know. So, here we know that you know and authors basically reasoned that if language experience shapes the neural responses to familiar and unfamiliar words the ERPs for one and the same child could actually be different between the dominant and weaker language or could actually be different depending upon their total conceptual vocabulary size. So, there are a bunch of factors that these people have manipulated which were not looked at in much detail by Vihmann and colleagues study. Moving to their analysis the authors focused on three time windows for their ERP analysis 200 to 400 milliseconds, 400 to 600 milliseconds and 600 to 900 milliseconds.

Their ERP analysis actually showed very clear effects of word type manipulations which would be qualified both by language dominance and total conceptual vocabulary size. The high total conceptual vocabulary size group actually exhibited an effect of word type basically familiar versus unfamiliar or known versus unknown in all the three time windows and in both the dominant and weaker languages. In contrast the low total conceptual vocabulary size in group actually showed the same effects when the participants were tested in their dominant language, but only in the 600 to 900 milliseconds time window when they were tested in their weaker language. So, you can see that based on whether a language is dominant or weaker the neural responses to known and unknown words is actually different. Now, on comparing these results with similar monolingual studies the authors concluded that in several respects the ERP patterns of both high and low TCB bilinguals resembled those of 13 to 17 month old normally developing monolingual infants or 20 month old late talkers.

So, basically what they are trying to suggest here is that word acquisition is slightly delayed in bilingual infants as compared to normally developing monolingual children. Further the different the responses for the high and low total vocabulary total conceptual vocabulary size infants also tells us that the amount of language exposure is actually a critical factor that affects the neural response to known and unknown words independent of the brain's maturational state. Now, Conboy Mills also hypothesized that the difference between the ERP responses for known and unknown words in their study actually implied a differential processing of meaning and not just differential word form recognition. Now, this was supported by some of the some later studies as well whereas, such as Mills and colleagues in 2005 and some other studies wherein brain responses of 20 month old infants were compared for two novel nonsense words which are associated to actual objects. So, that they had some meaning and two novel nonsense words which are not associated to you know objects in a sense that they did not have any meaning.

When these when the brain responses to these two pairs of words were actually compared they differed from each other in the same manner as the responses to known and unknown words differed in Conboy Mills 2006 study which basically tells us that both of these groups of infants are actually responding to word meaning rather than just to word form. So, to summarize from the results of the above two studies we can conclude that infants around 20 months of age are actually capable of linking word forms with their meanings. The same is indexed in their neural responses also you know as seen in these ERP studies. Also the amount of language exposure is critical in the development of these word form you know word form and meaning associations even more than the brains maturational state. Finally you could also conclude from these set of studies that word learning may be slightly delayed in bilingual infants as compared to monolingual infants although it is not a large delays.

It is probably a delay of a month or two which basically you know gets caught up and it has been shown in you know later studies that bilingual infants catch up with their monolingual peers monolingual peers very rapidly at around 20 you know at around 20 months of age and so on. So, this is basically all that I wanted to say about linking word forms to meanings for bilingual infants and we will talk about another aspect of word of language acquisition in the lectures of the next week. Thank you. .