Psychology of Bilingualism and Multilingualism
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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. In this week I have been talking to you about language control issues in bilinguals and multilinguals. Now so far we have seen that a proactive model of language control was manifested in Grosjean's language mode theory. Interestingly, it basically followed a proactive control mechanism in order to prepare a particular language of choice and sort of make it ready for selection and so on and so forth.

This model actually serves as a very interesting illustration of how bilinguals dynamically adapt to the communicative demands of a situation and manage their behaviour accordingly. Another important proposal in this area is that of an inhibitory control system that allows bilinguals to suppress the activations in the non-target language. In today's lecture, I will talk to you in more detail about this inhibitory control model followed by David Green and we will ponder about the theoretical implications of the model and so on and how that sort of manifests in bilingual language behaviour. Indeed, researchers have actually opined that an account of linguistic performance is actually incomplete without a description of the control system that enables the use of target language as and when intended.

One of the prominent researchers in this area has been David Green who has emphasised the importance of efficient and unobstructed control operations in the language of choice and also of sufficient resources to be utilised in these processes. An emerging view from Green's proposal has been that processes involved in bilingual language control may actually resemble control processes that are involved in other situations as well, such as when a response has to be selected from within a few response candidates and has to be you know suppressed in a given scenario. Now remember, this actually resembles the proposal by Mcnamara and colleagues who had actually concluded that language switching performance is basically not something which is very specific to language behaviour per se but is generally applicable to all kinds of situations where individuals are asked to switch between responses rapidly. Now we will evaluate this assumption, we will evaluate these ideas a little bit more in detail as we go ahead to the next slides. Let's look at the inhibitory control model by David Green in a bit more detail.

The main construct in Green's inhibitory control model is the supervisory attentional system or the SAS which has actually been adopted from Norman and Schallice's theory on control of behaviour. Now this SAS or the supervisory attentional system has actually been envisioned as a resource limited control structure that is involved in the planning, regulation and verification of non-routine voluntary actions, new actions that keep popping up and that is assumed to be housed in the prefrontal regions of the brain, the prefrontal cortex, the dorsolateral prefrontal cortex, the anterior cingulate and so on and so forth. Now more importantly it can be thought of as a subsystem which is part of the larger system in which simple and well-learned actions are actually carried out automatically by ready-made memory structures that specify these action sequences called schemas. Say for example when we are driving and we have to change the gear and for example you have to change the radio station or change lanes and so on, these are well practiced tasks and it would probably, once I have done this enough number of times, it will create memory structures or schemas that specify how these tasks have to be done, how do I have to change from first gear to fourth gear or from fourth gear to first gear and so on. So typically what will happen is that these subsystems can just bang upon, retrieve these language schemas and allow for me, you know and allow me to change between these different tasks.

Let's have a look at this model in a bit more detail. So here you can see the inhibitory control model as specified by David Green in 1998. You can see that there are few parts of this which are important. There is goal, there is a conceptualizer, the conceptualizer is mediated by the supervisory attentional system. There is a language task schema.

Which language do I need to perform in given a particular communicative scenario? The language task schema interacts with the bilingual lexico-semantic system basically containing candidates from both of my mental lexicons, you know language, L1 lexicon and an L2 lexicon. There is an input and then the output. So input basically goes through the bilingual lexico-semantic system, meets with the language task schema, interacts with the SAS, the conceptualizer and the goal of the present scenario and basically and that is sort of also, you know expressed in the output. Let us look at this model in a bit more detail as I have sort of, you know, very cursorily described it so far. Now the supervisory attentional system actually supervises the routine running of schemas and intervenes when necessary whenever a new task is required, whenever a new job has to be done.

This supervisory attentional system can actually accomplish the same by altering the activation levels of the running schemas, you know, a schema for changing gears, a schema for changing radio station, a schema for applying brakes, this and that and those will be recruited as and when the time is right. It must be noted before we sort of go on

and you know describe this in a bit more detail, it must be noted that green actually uses the term schema not only in the reference to the ready-made structures that can be retrieved from the long-term memory and have resulted from the past experiences I have been talking about. He also talks about schemas in terms of mental devices or networks that individuals may construct to adapt, you know, on the spot in order to achieve the task demands of any specific scenario. You know, when you land in a new situation and a new task is there, maybe we create a schema on the spot and the supervisory attentional system tries to recruit the schema for, you know, completing the task at hand or fulfilling the goal at hand. So in this sense, a task schema may be akin to participants understanding the instructions in a bilingualism experiment that actually allows them to modify their linguistic behavior as needed.

You know, you have to switch into Hindi, you have to switch into English, you have to continue speaking in Hindi or continue speaking in English. Depending upon the task requirements, I can actually, the SAS can actually enable me to modify my language behavior as and when needed. Now the task schemas for tasks that have been previously performed, say for example, an easy task like reading aloud can actually be retrieved from memory as such or modified online depending upon, you know, what I have to read, how fast or how slow I have to read and so on. And schemas for tasks that are novel may need to be constructed on the spot as I was just saying. Now, an important aspect in Green's model is this concept of a conceptualizer which has been envisioned as the non-linguistic system that develops the conceptual representations from information in the long term memory.

So it basically draws from the long term memory and creates a conceptual representation of what needs to be done in a given scenario. This conceptualizer is actually motivated by a goal to achieve some effect through the use of language. Say for example, in a language switching experiment, the intention to produce a word in a specific language is a task requirement which will basically be interpreted by the conceptualizer and the conceptualizer will basically develop a scheme of how to, you know, produce the name in a given language. Now there is another important part that we were seeing in the figure is the bilingual lexico-semantic system. The bilingual lexico-semantic system is actually viewed as part of the actual language system, the overall language system and is supposed to store the bilingual word knowledge, for instance, knowledge about word forms and meanings in both the languages of the bilingual.

Alright. So basically this is the overall mental lexicon that I may be talking about. Now another very important concept in Green's inhibitory control model is this idea of the lemma. The lemma basically, and we've talked about the lemma in a lot of detail in the language production chapter as well, also I've talked about lemma in the course on

psycholimistics that I've given. Now lemma basically you might know that it specifies the syntactic properties of a word, also, you know, some aspects of its meaning. Now in Green's inhibitory control model, lemma basically specifies, not only specifies the word's syntactic properties, such as its gender, tense, number agreement and so on, but it also carries a language tag that specifies the word's language membership.

So this information is also supposed to be embedded in the lemma for a given word. Let's take an example. For instance, during word production task, conceptual information from the conceptualizer would activate lemmas in the bilingual lexico-semantic system proportional to the degree of information that is shared between the conceptual representations and the lemmas in the lexico-semantic system. So if I have to name a particular picture in English, then it will proportionately activate, and the concept in English, based on the match between the stimulus input and the aspects of the lemma in the lexico-semantic system, it will map these and it will proportionately activate it. So for some concepts that I am best at expressing in English, and English words lemmas will be activated, concepts which I am best at expressing in Hindi, the Hindi words lemmas will be more activated.

Moving on, two very important characteristics of Green's inhibitory control model may be pointed out. First is that it includes an explicit control mechanism like the SAS that we've been talking about, which can regulate the language behavior by setting up, by retrieving or setting up task schemas that specify in what way the language system must be used to perform the expected task. And second is the process of a reactive local suppression of contextually inappropriate lexical elements, the idea of suppressing the output of the non-target language system. So for instance, let's take an example, when the goal is to perform a particular task, the SAS installs the relevant language task schema. Now this relevant language task schema, what it would do is that it would control the behavior in specific ways.

It would alter the activation levels of the lemmas in the lexical semantic system and inhibit pending outputs from the system, which are from the non-target or irrelevant language. Explaining this in more detail, for example, if a bilingual is required to name pictures in their L2, you know, the relevant schema is activated and it enables task performance by increasing the activation levels of the lemmas in L2 language with L2 language tag and decreasing the activation levels of the lemmas with L1 language tag by reactively inhibiting their output. Now the degree of this reactive inhibition that will be applied will be proportional to the level of activation in the non-target language lexical items. The more active they have already been, the more they will need to be inhibited. Now this is a very, very important point.

What we are saying here is that for a particular bilingual, there will be some kind of a base activation of these items. Whatever the base activation is, the reactive suppression or the inhibition that needs to be applied will be proportional to that. For example, if I am, as I keep saying, I'm a Hindi-English bilingual, Hindi is my native language, the lexical elements of Hindi will be certainly much more active and they will be highly available for selection, whereas items from English will probably be less, let's say, you know, for argument's sake, will be less active and will therefore have lower resting state activation levels. If I have to inhibit either of the two, what will be required? If I have to inhibit items from my L2, which is not my dominant language, which is my weaker language and which already has items with lower levels of activation, the amount of inhibition required will also be less. If I have to, on the other hand, try and inhibit my items from Hindi or my first language, which are already activated and the base level activations are higher, I will need to apply more inhibition.

So this is basically the idea of disproportionate inhibition being applied for dominant versus weaker language. Now let's move ahead. So it seems that according to Green, control can be exerted on one hand, both proactively and globally by adapting the activation levels of all the lemmas in both the language subsets before the task performance starts. But on the other hand, it can also be applied reactively by suppressing the activation in the lemmas from the non-response language category. Now De Groot suggests that technically the model can also do without proposing the proactive control altogether because the model actually rests on this reactive suppression inhibitory control sort of idea.

Now let's look at how these assumptions will play out in actual experiments by looking at a study by Meuter and Allport, which actually provided a lot of support to this model. Now Meuter and Allport actually asked their participants to name Arabic numerals in either their L1 or L2 using the paradigm of the language switching task, which we have discussed so far. Interestingly, in this study, Meuter and Allport measured the participants' response time for every single trial. So for every single switch trial and every single non-switch trial, they had actually computed costs. Now this actually allowed them to test their hypothesis of relative strength of the two languages.

Just what I was repeating in the previous slide, the idea is that the resting relative strength of L1 will be slightly higher than the resting relative strength of my L2. And according to this relative strength hypothesis or following from this relative strength hypothesis, Meuter and Allport actually predicted that the switching cost would be slightly higher for a switch trial when I'm switching into the L1, whereas when I'm switching into the L2. Now if you look at this assumption, it seems a little counterintuitive. Why does it seem counterintuitive? Switching into L1, which is my base

language, which is my dominant language, should be easy. It should be easier for me to go and name in Hindi.

It should be easier for me to switch from naming in English to naming in Hindi. But remember what we have been talking in the previous slide. We have been saying that if I have been naming in English so far and now I want to switch in Hindi, I need to overcome the inhibition that has been applied on Hindi. What was I saying in the previous slide? I was saying that there is disproportionate inhibition applied on lexical items of Hindi and lexical items of English, lexical items of my L1 and lexical items of my L2. And therefore switching into Hindi will require me to overcome that disproportionately high inhibition that has already been applied.

And hence it would incur more cost. And when I'm switching into English, because lower inhibition would need to be applied, lower effort included to overcome this inhibition, it will be easier. So the switching cost into Hindi will be slightly higher than the switching cost into English is what these guys actually estimated. Now, Meuter and Allport had actually derived this prediction from similar asymmetries that had been observed in scenarios where the participants are actually required to switch between an easy task, a well-practiced task and a hard task, which is less practice. For instance, say for example, word reading is a very easy and highly practiced task by fluent readers, whereas color naming is something that is unnatural typically and it may require a lot more effort.

Now, the cost that has been found to be incurred during such switches is typically larger when the participants had to switch from the weaker task, that is color naming, to the more dominant task, that is word reading. Then when they had to switch in the reverse direction, that is from the dominant to the weaker task. Now, this is slightly counterintuitive as I was just saying, but it has been explained in terms of differences required in the level of the non-target task along with the concept of task set inertia. So I've already talked about this difference of inhibition that is there and the difference of effort that is required to overcome that inhibition. Let's talk a little bit about this task inertia thing.

Now, this task set inertia basically refers to the idea that the task set of the previous trials must carry over into the current trial and hence switching into a different task should be inherently difficult. Basically, what am I saying? If I am doing something continuously on previous trials, English, English, English, English, English, then obviously I have developed a certain kind of inertia, I have developed certain kind of momentum and to switch from English to Hindi will be slightly more difficult. Similarly, if I have been naming in Hindi, Hindi, Hindi, then switching to English will be obviously more

difficult. Add to that the disproportionate inhibition that has been applied on Hindi versus English and that basically will help you to understand that there will be this asymmetric switching cost that we are expecting when people are switching into English versus when they are switching into Hindi. Now, Meuter and Allport deriving from these observations hypothesize that the language switching task actually implements the same general paradigm that requires individuals to switch between a more practiced task and a less practiced task and therefore predict a similar asymmetry in their data.

Indeed, from the results, language switching into both languages did incur a cost, a finding that is similar to earlier findings from language switching studies done by Kollers and colleagues, Mcnamara and colleagues and so on and it has also been replicated in a number of later studies. But more importantly, the predicted switching asymmetry was also observed. So, participants actually incurred more switching costs when switching into their dominant language as opposed to when switching into their weaker language. These findings again supported the analogy taken by Meuter and Allport as the basis for their predictions. Moreover, the findings and analysis were different in their scope from Mcnamara and colleagues study as the latter had not calculated switches per trial and hence did not observe these asymmetries but it still confirms the latter's original idea.

What was their original idea or the original conclusion? It was that language switching seems to require no psychological skill peculiar to bilingualism but rather a skill which is equally applicable in a larger number of operations in which people are asked to switch modes of response rapidly. Now again, this is what I began this whole lecture with. I'm trying to remind you that the findings from Meuter and Allport study is very similar or the implications of the inhibitory control model is very similar to domain general interpretation of language control that was also sort of deduced by Mcnamara and colleagues from their initial studies. Now let's move on and look at some of the other studies. Moving on, given that these observed asymmetries in switching are actually a consequence of the participants level of practice or proficiency in the involved task, you know a well-practiced task or a dominant language versus a less practiced task or a non-divertant language, technically they should disappear if the individuals are equally proficient in both the languages and there is no asymmetry in their proficiency.

Indeed this was found when balanced bilinguals you know were actually used for these language switching tasks both by Meuter and Allport and some of the other studies say for example Costa and Santesteban in 2004, they actually found that the asymmetries in switch costs actually disappeared when balanced bilinguals were recruited for these tasks. However, look at the results more closely, costa and Santesteban actually considered an alternative explanation for the absence of switching costs or switching cost asymmetries that were observed with the balanced bilinguals. They actually proposed that balanced

bilinguals may be employing a qualitatively different sort of a selection mechanism, one that does not require the use of reactive inimition. So they are basically saying while we are observing the same asymmetries, maybe the explanation is not what is coming from the reactive separation or the inhibitory control model but there may be an entirely different reason to this. So they tested this proposal by looking at the switching behavior of early balanced proficient Spanish Catalan bilinguals who are actually learners of yet another a third language and the switching tasks that they gave these people were actually involved switching between their L1 and their L3.

Now according to the reactive separation account, the switching cost should have re-emerged because again there is a you know there is an asymmetry between the strength of L1 and L3 obviously but contrary to this prediction the switching costs were equal when these participants were switching into L1 or into L3 which is obviously you know it does not really agree with the reactive separation or the inhibitory control account that we have been talking about. So based on these findings the research has actually concluded that the language selection in participants that are highly proficient in at least two languages might not come through reactive separation rather it may come through a control mechanism that only takes lexical elements of the response language into consideration for selection processes and ignores the activated lexical items from the non-target language. Remember we were talking about this in the production chapter that language non-selective activation but language selective selection procedures are actually imbued are actually involved when we are talking about production. So interesting you know some of the later studies actually supported this language selective selection hypothesis that was put forward by Costa and colleagues. Interestingly when they sort of rehashed this study with quadrilinguals, researchers discovered that there are certainly boundary conditions to this language specific selection account as well.

For instance they propose that the language specific selection account you know mechanism for for this to be operative at least a high command of one of the three or four languages that we are testing with should be there so that there is that asymmetry otherwise it will not really happen. Finally to account for these complex patterns of results Costa and colleagues actually tentatively proposed another hypothesis and the hypothesis was that for a language specific selection mechanism to be roped in the words must be you know sordidly embedded within language specific lexicons because basically what we are doing in language naming or language switching task is that we are actually retrieving these words from these language specific accounts and if the words are solidly embedded into these different lexicons that bilinguals and multilinguals have only then you know you will need more effort or less effort to activate or deactivate them. In absence of such a condition where the words are not very solidly embedded into these you know language specific lexicons, participants you know would need to resort to the

reactive separation strategies again which will lead to the re-emergence of switch cost asymmetries. Interestingly in the in the final study that I wanted to discuss when Gollan and Ferreira actually conducted a language switching experiment where participants were actually allowed to do voluntary switching you know they had basically just said okay you may choose to sort of you know use name a particular picture in either Spanish and English the response patterns in balanced and unbalanced bilinguals are very very similar and both of these you know results actually did not support the idea of reactive inhibition. So again while reactive inhibition actually seems like a very plausible you know account for bilingual language behavior in these language switching tasks there are certainly more or alternative different explanations that are possible and we can you know continue debating about them and researching about them as some of us are actually doing.

So to summarize my discussion on language control based on the research that we have looked so far it seems clear that bilinguals certainly benefit from a control system that manifests differently depending upon the experimental task situation and task demands. However, the nature of this control system whether it is proactive reactive or it is entirely different you know is it domain just specific or domain general actually is far from clear and needs to be further investigated. That's all that I wanted to talk to you about with respect to language control and I'll see you in the next week with a different chapter and we'll continue our journey into understanding language recognition in bilinguals and multilinguals. Thank you.