Fundamentals of language Acquisition

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Week 12

Lecture 059

Lec 59: Down syndrome

Welcome back! We are starting with lecture 4 in this module, module 12. In lecture 3, we looked at autism spectrum disorder and developmental dyslexia. Now we will look at some symptoms of language disorders with respect to Down syndrome. Now Down syndrome is yet another well-studied and well-known disorder that is a developmental disorder. Down syndrome is one of the most common genetic causes of intellectual disability. This is found in approximately 1 in 700 live births. This is a statistic that we have found from the Centers for Disease Control and Prevention. Ninety-eight percent of cases of Down syndrome are caused by an extra copy of chromosome 21; actually, Down syndrome is primarily a genetic disorder due to certain malformations of the genetic material. we have this particular outcome. So, one of them is, of course, that there are many other reasons, but one of them is that this is actually very prevalent: 98 percent of the cases of all Down syndrome patients are caused by an extra copy of a particular chromosome.

And this can occur in any race, socioeconomic status, or geographic location; this is prevalent across the world. The only etiological factor undoubtedly linked to Down syndrome is considered to be an increasing maternal age. So, this is something that has been reported by one particular study: there seems to be a direct correlation between increasing maternal age and Down syndrome. Now Down syndrome is, though it is primarily a genetic issue, there are many problems that you will see concurrently. There will be hearing problems, language-related problems, and others, so we will take them up one by one. Hearing skill problems are very common among children with Down syndrome; approximately two-thirds of these children experience conductive hearing loss, sensory neural hearing loss, or both. So, hearing loss is a problem that is quite

common among Down syndrome patients. Otitis media is one cause of mild to moderate fluctuating conductive hearing loss. This is one of the reasons for this kind of hearing loss, and it is found very, very often in children with Down syndrome as well. So, they may be particularly susceptible because of the narrow auditory canals and craniofacial differences. Children with Down syndrome have a very particular kind of facial structure which probably leads to narrow auditory canals and craniofacial features. So, because of this, they might be more susceptible to otitis media, which is the underlying reason for various kinds of hearing loss. So, this is the connection that has been proposed as a reason for the hearing skill problem with children who have Down syndrome. They also have oral motor skill-related issues. So, they tend to exhibit differences in oral structures and functions. Structural differences include a small oral cavity with a relatively large tongue and a narrow, high-arched palate. So, the structure of their oral cavity is also different as opposed to normally typically developing children. Missing, poorly differentiated, or additional muscles are also part of their facial features. So, some muscles might be missing, some might be poorly differentiated, and sometimes even additional muscles are part of their facial structure. So, these factors are considered responsible for their poor speech intelligibility.

 So, children with Down syndrome have hearing-related issues; their speech is also poor, marked by poor intelligibility. It is not very easy to understand, and that is probably because the different kinds of muscular structure and the overall facial structure are different. So, that might be responsible for the problem. At a cognitive level, about 80 percent of individuals with Down syndrome have moderate intellectual disability, although some have severe intellectual disability as well, and others have IQ scores in the average range. So, it is again a variable kind of group; not everybody has the same level of cognitive disability. Some of them have average IQ, while others have serious deficits in cognitive level. Visual-spatial processing and perception are generally viewed as strengths. If you recall, we looked at Williams syndrome; in the case of Williams syndrome, the visual spatial skills were seriously affected. but in case of Down syndrome that is not the case they often have this is one of their strengths even though they have their cognitive abilities or other cognitive abilities may not be at par but visual spatial processing and perception are almost intact in most cases some cases it might be different again. Social skills in children with Down syndrome are typically characterized as highly social, engaging, and affectionate.

 So, this is where there is a similarity between Down syndrome and Williams syndrome. Children with Williams syndrome that we have seen are characterized by being very

talkative and very sociable, having a cocktail party personality. Children with Down syndrome are not called cocktail party personalities, but they are also highly sociable as opposed to those with autism spectrum disorder. So, autistic children typically tend to be you know limited to themselves, they are very they do not they do not open up, they do not have they do not have social skills as such, but Down syndrome children do. So, these are the differences and similarities among disabilities. Socialization and daily living skills appear to be their strengths compared with communication. Children with Down syndrome form interpersonal relationships in much the same way as typically developing children. So, just like other children, those with Down syndrome will be making friends and engaging in social activities. So, on this scale, they do not show any serious disability when you compare them with the control group. Now, we will look at language learning abilities.

So, as with many other disorders, children with Down syndrome show more impairment in expressive than in receptive learning skills, which is not only common across disorders but also in terms of normally developing children; this is seen at a particular stage where that difference remains. Children with Down syndrome have poorer speech intelligibility than younger typically developing children of similar non-verbal mental age, not chronological age, but when you match them with mental age-matched control groups that are younger than them because their mental age is less than their chronological age, they seem to have poorer speech intelligibility. Some of the phonological processes, like systematic sound errors and simplification patterns, continue for a longer time than their MA-matched controls. So, for example, small children often make very simplified sounds; we have seen it in our phonological chapter, where there are certain kinds of simplifications that children follow. For children with Down syndrome, those simplifications and those errors continue for a longer time as opposed to their controls.

In terms of receptive vocabulary, there is a level of contradiction because some studies report poor receptive vocabulary, whereas on the other hand, some studies do report very good receptive vocabulary, good in the sense that they are comparable to neurotypical children. So, there is a bit of a contradiction. We have results from both perspectives. A similar contradiction is also found in the expressive vocabulary. Though quite a few studies have reported that their proficiency in expressive vocabulary is poorer compared to their mental age-matched control, expressive vocabulary in case of receptive vocabulary seems to indicate that they are generally not very well categorized in any of the categories. So, the contradiction is kind of biased, but in the case of expressive vocabulary, more studies report that they are not on par with their MA-matched control groups. In the case of syntax, vocabulary, and phonology, we have seen that now we are moving to syntax. In syntax, several studies have shown that syntax is more impaired than vocabulary in both receptive and expressive domains; however, the studies in the

case of vocabulary have reported contradictory findings. In the case of syntax, there seems to be more consensus that syntax in both receptive and expressive domains is quite seriously affected. For example, there have been many studies in the literature, and we have adequate literature on the linguistic repertoire of children with Down syndrome.

One particular study reported that a group of 31 boys with Down syndrome produced less complex noun phrases, verb phrases, sentence structures, and less complex questions and negations. So in all of these domains, including noun phrases, verb phrases, sentence structure, as well as complex questions and negation. So in all of these important domains, their production in terms of syntactic structure was comparatively much less complicated. So they tended to use simple sentences. Overall, some children with Down syndrome are competent in language skills. However, most are not. There are enough reports of children with Down syndrome doing pretty well with their language skills. However, a larger number of reports have been coming from those patients who are not really well. The initial stage of language acquisition, from 0 to 4 years, shows comparable language acquisition with mental age-matched controls but lags behind in terms of the chronological age-matched controls. That is the initial stage, but after that stage, lexical and grammatical development also becomes very slow. So, in terms of vocabulary acquisition as well as in terms of the syntactic acquisitions, both in the receptive and expressive domains, grammar as well as vocabulary tends to become slow after a period of time.

So, in the initial stages, they seem to do well, but later on, there is a slowing down. So this is about our language-related problems concerning Down syndrome. Now no discussion on atypical children will be complete without focusing a little bit of attention on the intervention methods. Of course, we will not be able to give you all the methods or discuss all the methods because of the paucity of time. So I will not go into the traditional methods of intervention that are well known and that all textbooks will give you. So, we are not going there. So, all the speech-language therapy and other kinds of therapies are there. What I will discuss in this segment is some of the recent intervention methods that we have encountered. Some of them have been proposed; some are not yet entirely attested. So, let us to look at some of those things So, inherent variability across patients makes it a very serious challenge for clinical practitioners who are treating these various kinds of disorders, be it dyslexia, autism spectrum disorder, Down syndrome, or whatever. Because there is a lot of variability not only overlap categories, but within categories also there are a lot of differences. So, as a result, many new kinds of intervention techniques have been proposed, and one thing to remember here is that all these new methods that have been proposed are used alongside the traditional intervention methods. So, alongside speech therapy, occupational therapy, and other

therapies, these processes are also recommended nowadays. So one of them is called hyperbaric oxygen therapy (HBOT). This has become popular recently. This is considered to alleviate the biochemical dysfunction and clinical symptoms in cases of ASD specifically, but it can also be used for other problems.

So biochemical dysfunction in the brain, if they have it, is kind of targeted, and as a result of the oxygen therapy, they tend to report. So there are some reports of the therapy actually being useful. So, a recent review of the method reports no improvement in the core cognitive deficits with the use of HBOT, but some other studies indicate that this is still in a very nascent stage as it has been introduced only a few years ago. So, obviously, you do not have a lot of data coming from this domain, but there are some domains. So, for example, some studies do say that it does not do anything to improve any of the core cognitive competencies, but maybe some superficial abilities might be impacted.

Overall, there is a lack of agreement on what HBOT does; basically, the children will be subjected to oxygen therapy. So, there will be a small room into which pure high-pressure oxygen will be injected, sort of, so to say. So, the room is filled with high-pressure oxygen, and the child has to just sit there for some time. And this process goes on for a few months, and over a period of time, this is supposed to interact with the dysfunction in certain kinds of biochemical dysfunction in the brain. Sometimes, what happens is that in some cases of these disorders, the diagnosis would be that the brain did not receive adequate oxygen during the fetal stage. So, in the prenatal stage, as a result of which, giving oxygen from outside may help eradicate some of the problems that the brain faced at that time. So, that is the idea, but the results, of course, are contradictory; as of now, some reports have suggested some positive outcomes, while others have not. There are not many negative impacts, but some studies say that there is not an adequate amount of positive impact on core cognitive competence. Another type that has been utilized for some time now is what is called educational robotics, which is, in short, ER. They use social robots, and the reason for using robots in many of these cases is that they can be utilized for multiple domains, not just one.

So, you can target social behavior; you can target joint attention. Joint attention is something that is seriously missing in children with ASD, for example. So, with the use of a robot, that problem can be addressed, and then, of course, language. Many of the studies have reported better engagement of the children, especially those with ASD, with humanoid robots, due partly to the fact that robots can simplify initial interaction and create a predictable environment for play. Autistic children prefer predictable

environments, and they also prefer not to interact with human agents, but they can actually interact with non-human agents. So, they can spend hours playing with some toys, a particular toy, or something. So, that is why educational robots can be a very useful tool. And in fact, they have been used very effectively in certain cases of autism spectrum disorder specifically, and this has been found to enhance their social skills as well as joint attention skills to some extent. But again, the results are mixed; sometimes there is no positive impact, there is no direct impact, but sometimes there is. Language can also be targeted because autistic children are specifically fond of repetitive behavior.

So, you can actually use certain kinds of language components that you want them to learn, and the robot can repeatedly use that, allowing the child to pick it up. So, these are some of the domains that educational robotics is targeting at the moment. A lot of work is still going on. So, with respect to language abilities, the results are less problematic than in other domains because there seems to be a better outcome for language as opposed to other social skills. As I just said, the repetitive nature of autistic children might benefit from the use of a robot in terms of teaching language. So, we do have some data that is pointing towards a positive outcome. Another idea is that of serious games. There are a number of serious games designed to help children learn languages. Most of these games are based on the behaviorist approach of repetition and reinforcement because that is how to keep their attention. Because you are talking about disorders, not normal children; you are talking about children with disorders. So, in that case, repetition often becomes a very useful tool. So, that is why most of these games are based on a behaviorist perspective. Often, these games target specific areas of interest, such as empathy, emotion regulation, language, and so on. Often, they do report a positive outcome. These are also verified through imaging studies that show greater activation in the relevant area.

So, over a period of time, you also see that the activation pattern in the brain has also gone through a change in the positive direction. Interestingly, not only serious games— these are serious games because they are designed to overtly teach something to children—but entertaining games have also been found to be useful for clinical purposes. For example, action video games have been found to activate areas of the prefrontal cortex, posterior parietal cortex, and temporal brain areas. So, these are areas with all the entertaining games because, in fact, there is a lot of data now coming from patients, particularly children, who play video games for a longer period of time. So, it is these games that have actually been found to have a spillover effect in various other domains of the brain, typically in the area of, let us say, selective attention, you know, focusing on certain things. So, various executive function related domains have also been found to be improved in case. So, the same can also be applied as therapy for clinical purposes

because these areas are responsible for executive function and memory. So, they can also be used as an intervention method for those patients where these things are missing or affected. So, positive results have been reported from the use of games focused on attentional training, like this particular methodology proposed by Spaniol et al. So, this is called computerized progressive attentional training, which has been built into the entertaining games.

So, this has been found to improve both emotional responses and social interactions. So, this is another domain. Now, all of these games, or whatever newer kinds of intervention methods are coming up, the idea is that they should be within a particular framework. Now, the potential of serious games has not yet been fully understood or utilized for at least ASD interventions. So, cognitive constructivism and social constructivism in this domain have become important areas to focus on, and based on those theoretical positions, games can be created and implemented. Similarly, another approach, which is called neuroconstructivism, has also been proposed of late: that basic level deficits have subtle cascading effects on numerous domains over development; as a result, this is another important theoretical domain to look at. So, interaction among genetic, cellular, neural, cognitive, behavioral, and environmental levels of description is what we need to take into account. So, the framework needed for serious games, as many have proposed, is this. So, the need of the hour is a mapping of game attributes to learning theories. Otherwise, unless you base it on a theoretical proposition, you might not be able to address all the relevant questions because many of these disorders are not just a one-point kind of problem.

They encompass not only language or one particular cognitive problem, but also a problem that encompasses a larger area, including neural, cellular, environmental, and linguistic aspects. So, as a result, if these intervention methods are based on some kind of theoretical construct, they will be more useful; that is what the latest discussions in the domain indicate. So, even when the target is to teach vocabulary, it can be embedded into a context for the cascading effect on other skills because that is what is often found in many of these cases, as we have talked about comorbidity in all of these cases and how the variability within categories and across category overlapping makes it a very complex problem. So, the cascading effect is seen in the disorder. So, similarly, a technique that has a cascading effect on other mental abilities should be in place. So, this is how the idea was proposed. So, in the case of behaviorism, you have practice drills. So, a system of rewards, feedback, and goals. In cognitivism, we have incremental learning, motivation, and attention span; these are the things that are targeted.

Constructivism focuses on scaffolding, surprise, learner control, and progress, and of course, on psychology. So, depending on your goal, the kind of disorder we are talking about, and the kind of cascading effect that we need, we can base our theory on any of these parameters. So this has been proposed by a recent study. Broadly speaking, we have seen that there are various kinds of language disorders; developmental disorders may co-occur with cognitive disorders or may not co-occur. But even when they are not part of another broader disorder, we have seen some amount of correlation with other factors that might be possible. As a result, language-related disorders or language-related delays are quite common across the board in many of these disorders. And for that, we need some kind of intervention method that has been proposed based on a scaffolding theory, giving a context so that when you are teaching language using various new-age intervention methods, you can also target all of these, or at least a few of these, cognitive and mental problems. So, in other words, rather than an engineering-centered or a computation-centered approach to create either educational robotics or serious games, we need to have these platforms as learner-centered, depending on what the learner needs.

So, if it is for ASD, one can create a design that is based on a socio-cognitive mechanism. So, in order to make them engage with the another agent and thereby learn language. So, while you are learning a language, you can also target the other EF-related functions. So, while doing so, it is a good idea to try and use the constructivist framework for a better outcome; this is what we are arriving at. Because constructivism actively takes into account, if you recall, constructivism as a theory says that the child creates knowledge. A child is an active participant in knowledge creation; they are not learning language as a passive absorber, as behaviorism proposes, nor is language just already there; they do not need to do anything; it is just there as universal grammar, as proposed by nativist theory. Constructivism, on the other hand, says that the child is an active participant in the entire process. so the environmental input the genetic underpinning the you know the language capacity which is inbuilt all of that they interact with the child's agency. So, if we utilize that framework, intervention methods might be more useful.

So, that is where we are as of today. So, as a result, some models have also been proposed; one of them is called the hierarchical computing systems model. There is a correlation between EF and language in TD children, and this is how it is conceptualized in this model. So, as per this model, the existence of two hierarchical systems, which are a habit system and a representational system, is part of the entire mechanism. The habit system is influenced by previous experience, and the representational system is influenced by conscious reflection on behavior, and this is aided by language. So, these two are hierarchically arranged and compete to guide goal-directed behavior.

So, we have the automatic habit system, which is basically an automatic system. The

representational system is something that is conscious, which is the voluntary kind of processing. So, automatic and voluntary processing they have a competition and they try to help us with the goal directed behavior. So, a language-aided system may override the habit system to achieve natural goal-directed behavior. The implication of this theory is that the interventions in one domain can improve the performance of the other.

So, not only are we talking about constructivism as a theoretical perspective, but now we also have a model that takes that perspective into account by predicting a process where there is a habit and then there is a representational system, and one representational system also has language as a component. So, as a result, if you target one component, it will have a cascading effect and will improve performance in the other domains as well. This is also called the spillover effect. So, thus improvement in language ability would help improve EF ability or vice versa. So, if you target the capacity related to executive function, it will help with language capacity or the other way around.

So, that is what the model predicts. So, to sum up, the developmental disorders can be domain-specific and affect language development only. However, newer findings do point to the fact that there might be more than meets the eye in that case as well. On the other hand, we have the number of neurodevelopmental disorders that show an impact on both cognitive and social and linguistic levels. So attempt to understand and find interventions; therefore, now focus on a broader level of engagement along with traditional therapies. So this is where we sum up this module; in the next lecture, we will look at and sum up the entire course. Thank you.