How The Brain Creates Mind
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Lecture - 04
Electrical activity in brain-1

So welcome again, and let me pick up from where I left and let me reiterate what wonder that the brain creates because we all are able to define our self, our thought, our memory but we will come to that later. Let us look at the physical thing, which I have was talking how the brain integrates and it such a smart process which has developed.

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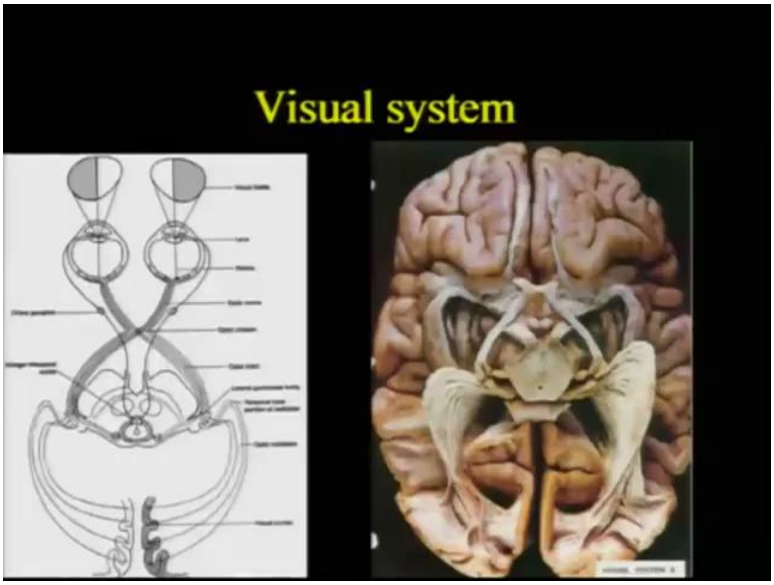

Just as I said auditory does up natural furrier and Repense a tonotopic frequency base representation in to the geniculate nucleus.

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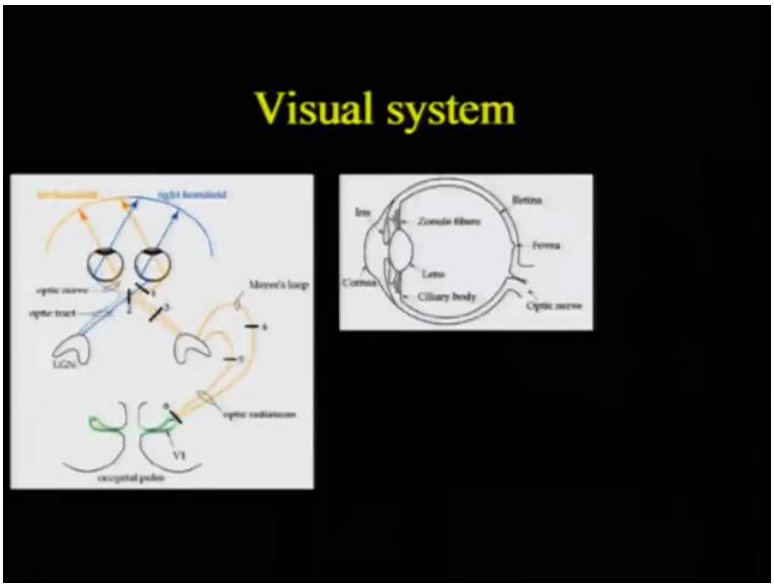

Visual system is the best study and as Francis crick who discovered the DNA helical shifted to Neurophysiology, later on writes in a book call "Astonishing hypothesis" which we should read, sometime get hold of it in both way, it has actually directed lot of research.

So as I said, you look at it is a left hemi field here, right here in between it Rely center thalamus; which every sensation has to pass through with. Thalamus is not just a Relay center, Thalamus also gets lot of projections from deeper areas called "Reticular activating system" which will talk when we talk of sleep. Thalamus if you remember the six layers initially I told you that fifth layer is the Pyramidal, where the output goes forth layer is where thalamus sends its input to the higher cortex and sixth layer where the cortex sends it to thalamus.

So Cortico thalamic loops we will talk about, when we talk of the brain networks. So the sensation comes into the 6 layers and as I said Axons from one eye labeled, and this is how it is presented what the brain does after this it uses network and now you can see how vision is a part of your mind, your hearing is a part of your mind, a sensations are part of your mind, they may work at a very physical level.

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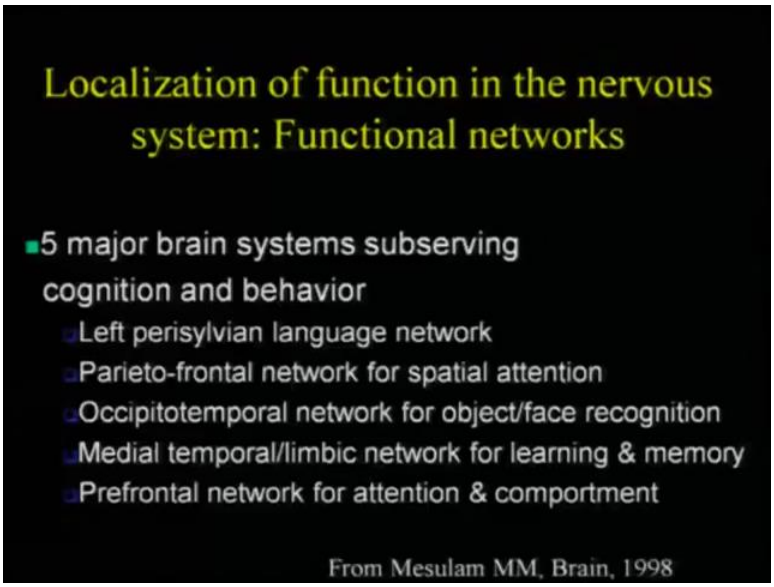

But actually it is all connected, now after the image is formed in the visual area; it is projected to as I said temporal, which decides what are you seeing parietal, where is it located because it is important signal has to go you know what signal has to go to your other parts of body, otherwise if you do not know where, how will you turn your head and see. To turn your head and see you have to know where, so the Parietal lobe tells you that then that composite image is sent to the higher center, where which decides whether you want to add to it, whether you want look at it, whether you what action you want to take, but before reaching there something else happens. There is deeper structure in the brain, which I have not mentioned that is called "Limbic area".

We will talk when we talk of emotion; limbic area and memory they also activate and compare if there is any previous image of that, object which you are seen. Because if you remember that example I give you that why do you suddenly see some bodies face and is start getting upset, because what happens what do you know about the face you are seeing, if there is no memory you will not have any emotion, a moment you see that face, that face which goes in is compared with the previous stored image of that, but it is not only the image which is compared. All the emotional drama which has been there in the memory; emotional memory will suddenly get

activated. And that emotional memory will label it on the basis of hierarchy, your mind will tell you it is a threat, last time this guy abuse me and my ego got shuttered.

So that emotions will compare these two images, and one compose it image will go to the higher center, which will decide be careful watch out; otherwise how do you know a dog is coming to bite you, it is a memory right. how many of you have seen a lion and how many of you experiencing a lion jumping on you, how many of you have shot by terrorist, but you have learned it from television, you have learn it from news paper, you have learn it from the experience of other. That is the quality of human beings. We not only learn from our experiences, we learn from other but your mind wants you, OK this man may be looking like a person, who will pull out a gun. This is also source of a something call "hallucinations" because for survival, your mind has to keep you oriented and in contact with the external reality.

Now suppose if somebody is putting a knife in front of me, obviously your minds will get threatened, but if I start feeling that, knife is not a knife it is a flower stick, I will damage myself, your brain may be internal image is telling which flower stick, or some strange experience or it is a plastic knife, but the reality is it is a real knife, so your conscious brain will suppress that internal imagery; like Corollary discharges is suppress it, so that your mind always remains in touch with reality, that is the basic purpose of brain networks, because if it is not in the touch with external reality, then you will hear yourself that is against life.

So because the basic function of brain network is to make you survive, to make you survive so that you reproduce to keep your humorous species is on, genes are pushing neurons are helping them to modulate and keeping you survive, that is the basic function. Rest all this details, how it does it is detail, why does it is to survive, once you born to survive. Most people have to avoid death, so brain always keeps in touch with the external reality because plus also, I will tell you when we talk about the evolution. That it is developed because of that.

So, the higher centers suppress the internal reality, if they match wonderful, if they do not match that is the best explanation we have till now. The mathematics and physics of it is at a deeper

level, how does it they do it. Basically does it through this networks, there are five major brain systems, left Pennsylvanian language network that is the temporal lobe. Parieto-frontal the sensory, and the frontal for spatial attention, as I said where Occipitotemporal from where you see to the temporal lobe for what object recognition. Medial temporal/limbic network for learning and memory, this is the emotional network as I said for learning what are you saying comparing a bearing in to the memory and forming memory and Prefrontal network for attention and compartment. Prefrontal network is this, in the frontal lobe.

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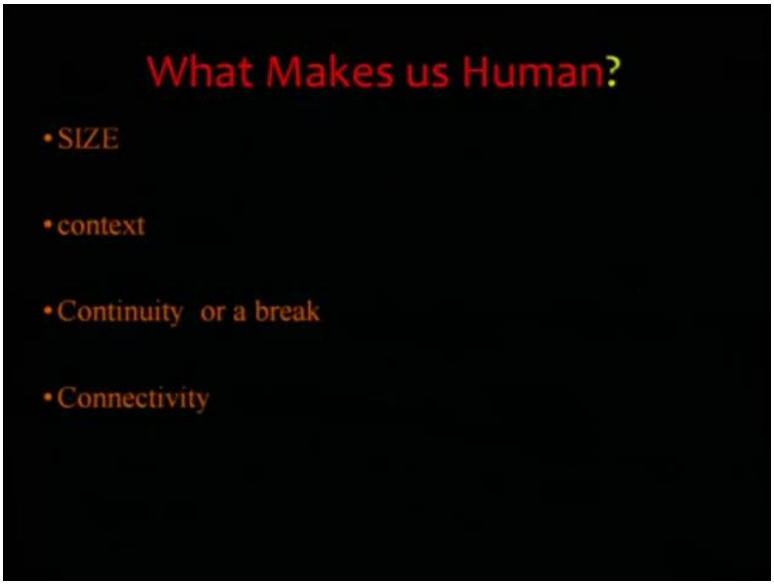

This area called "Dorsolateral prefrontal cortex" which is the not the decision maker, but this is the actual comparator of what is being put, what goes there, extract thinking, judgment so we have what you call default mode network; which is a from deeper parietal, deeper temporal, deeper structure of frontal lobe. Inside of it which is at rest?

Then we have what you call a salience network, this you saw that Corpus callosum which connected, next to Singulate gyros. The Singulate area and there is a small area call Insula, which extracts the salience of the image the input which is goes to the higher cortex, but

remember all this is happening at a very unconscious level, when you become aware by that time already 200 millisecond to 500 milliseconds of past, and the central executive network is this prefrontal cortex and all that will decides, central executive decides to pay attention; not to pay attention, to have a movement, to run away, to but all that but what it gets, gets after lot of processing.

So we look at it now, what makes us human? Again back to the same question, is it the size elephant brain is larger in size, is it the context. Yes possibly, because we all low human being can stand in isolation; all our acts. Can you tell me any of your acts which is out of context, all actions, all feelings everything has to be in a context, whether it is continuity of it. Continuity means that, once we have got born, I get this entire stimulus, I form a memory, there is a certain way have been brought up. All that goes into me and that forms continuity or is the connectivity, the way we can connect to other human beings; way we can connect to.

Now given all this, so now if you broadly if you ask me to sum up in few sentences before I move on into the deeper level, so I just mention few levels in the beginning, so we actually adjust the second level, if you look at, then we have talked lot of thing so redo a certain behavior, that behavior originates from the brain, the brain has certain 2 hemispheres, which are connected by Corpus callosum.

Certain areas which are specialize function not in the sense of exact localization. which has 10 to the power 11 neurons and 10 to the power 15 synapses, they are networks which connect all these neurons and in a very complex network, which we will talk about sensory input goes in, it is goes to the Rely center, Thalamus present to the Parietal lobe, Parietal lobe and again processes then goes to the Frontal lobe, Frontal lobe takes decision on it, and we do a certain behavior, in between the process the emotional brain, which is deeper brain evaluates, all the stimulus on the relevant hierarchy; compares with memory decides, whether it has to be worked upon or not worked upon and whatever is relevant, the Prefrontal cortex decides on it, to keep in us touch with reality by suppressing the corollary. So anything in this huge network can go

around which are the causes of illnesses. We may not be able to prove it just now, but these are the reason and all this is to survive and propagate the Espasis.

Now broadly brain works like this, and then they are networks which re default mode networks, there is a salience network and there is central executive network. These networks help you orient yourself help you identify objects, your memory keeps continuity and the brain itself does lot of what you know mathematically, as I said Fourier transforming or retry thing. And the Electromagnetic radiation which comes in triggers of this, and the way it is in present and the feature extraction is done image for, so all this complex stuff which brain is doing. this is the whole base line of functioning, a life deeper structures of the brain, they control your expiration, your heart rate, your absorption, is all under the control Cranial nerves, which are that 10 cranial nerves which control your eye movement, your facial movement, even if you take a small things like smiling, all of us smile a like, but the number of complicated facial muscles, which move is huge; your sensation. You are chewing, your heart rate, and then they are 2 other system call "Sympathetic and Parasympathetic" but these 2 systems, one is governed by Neuron chemist, I will tell you when we talk of in the in the next lecture.

They control lot in involuntary movement, like the way the stomach, stomach is like a bag with 2 muscles. It contracts; stomach closes or even when you have to urinate, there is inter, so inters are under control of this Sympathetic and Parasympathetic. Which keep functioning all the time, which you do not know, when you get a sudden heart rate in your anxiety, that is the role of sympathetic and parasympathetic play eventfully under the control of the deeper structure called "Limbic system" that limbic emotional system again controls this physical expression of emotion, which is through this 2 system call sympathetic and parasympathetic, which used different neuron transmitter you will talk about in the in the in the next step.

So I will switch on to different lecture just to continue it, before actually moving on to the function I wanted to discuss something, which you can discuss in short, any idea why brain is evolved like this, so if we look at the How's and Why's; there are some questions which coming why does lecture evolves so many spaces in the same environment, in salt water we will find

thousand things, in fresh water thousands things, they not many human being but even then they have of 5 type of human beings at this same time.

Why does brain need so many Neurons, it could have done with a simpler network and how does it evolve to be a complex network. Probably the answer comes in, what once the gene the neural system is started involving lot of it evolves in the reaction to the environment. So brain has and I am talking a brain, I am talking a simplest brain like, let us call first brain, which appears in octopus or earthworm, where the first structure of the brain comes in, and in evolution what you see is something call ontogeny recapitulate phylogeny.

Phylogeny is the development of a species, ontogeny is the development of individual person, it is very very interesting to find. So I told you what the brain; which is the motor area, which controls the movement. It is a limbic area, which controls the emotion and there is higher area called "Thinking brain". So this is the thinking brain or the Neo cortex. The structure of 6 layer which I told came last in the evolution Amoeba moves, Hydra moves, Octopus moves, Fish moves, motor area is present everywhere, in Vertebrates, sensations are there primal form of communication of speak sound is there, you come to Mammals emotions also come; dogs laugh, dogs cry. Horses laugh cry, Elephants do that, so it was a motor area, then it was emotional brain which came, and last evolve was thinking brain, in chimpanzees and primates and the last two complexity was human, which is different.

Why did it evolve? Probably what was happening, it is a probable thing as the neurons were forming and forming this network even if there were 2 neurons and 10 neurons, as they form in response to the environment, they form this synapses, but once the synapses wonder once the neurons were on, they have to keep functioning. Even in the lack of stimulation the new dimensions keep appearing with every new act is a new motor connection or a sensory connection happens.

So complexity kept evolving as the, animals kept responding to the environment. And that is how all this so it is like a huge experimentation, it is like almost non linear thing. In non linear

thing, obviously new dimensions and evaluation, if you do not know once it evolved, then it state back; if it was useful. Mutations happen in natural selection, never decides thing on in positive things. Like if something is functioning, where why will nature evolve and then something new happens, if it is deficient then it causes problem, it will be out of natural selection. But sometime it is use full and it continues, similarly there is something to adamant calls it a "Neural Darwinism". Neural Darwinism is the brain functioning has created some new dimension, and if it is use full or productivity keep persisting.

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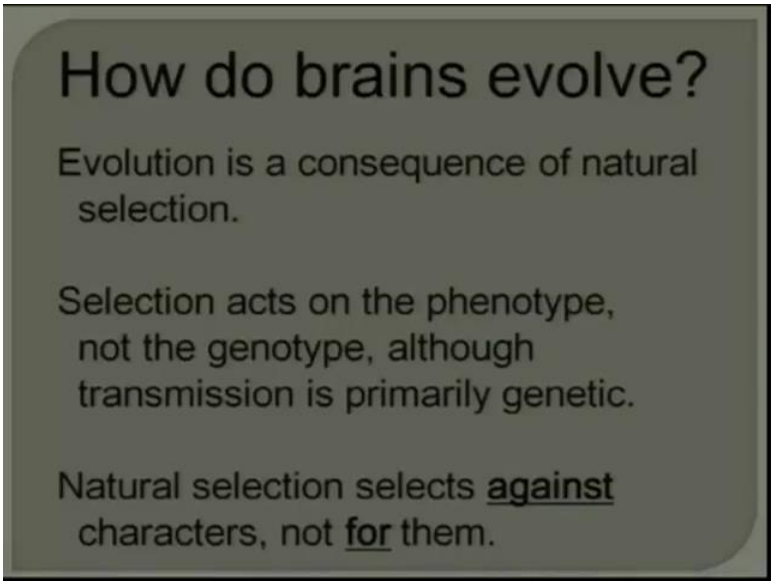

So this is phylogeny, so evolution is the consequence of natural selection, it acts on the phenotype not the genotype. Although transmission is genetic, you understand Phenotype is what expression is and what is materialized. So people will die and live on that, animals or whatever; but actually it is the genes which are transmitting this, when I am saying this it against character as I said if there is a def set, natural selection will try to eliminate it not for it.

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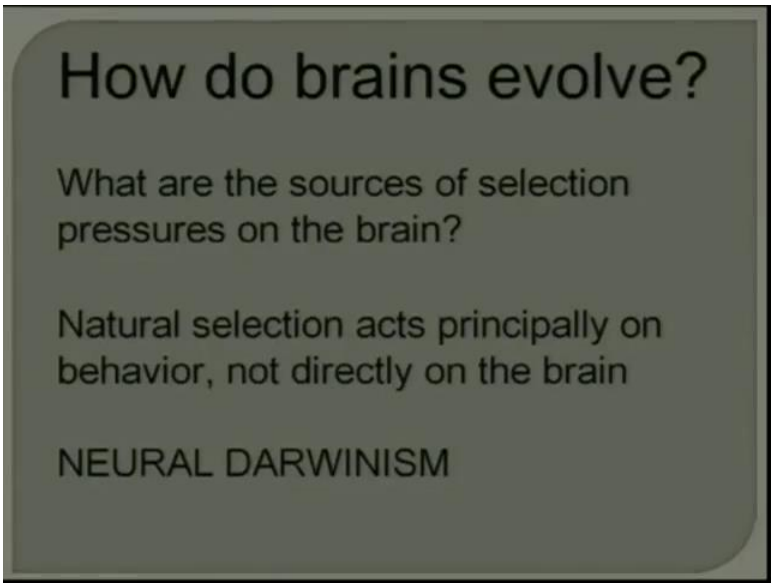

But then this is funny, because so what are the sources of selection pressures; as I said Neural Darwinism, natural selection will decide whether this behavior of view will make you survive or not. It is not acting on your brain. If I go and jump in the fire, I will die. So by brain is not acting on the brain, it is acting on my behavior. But ultimately many suggest that, instances brain will learn.

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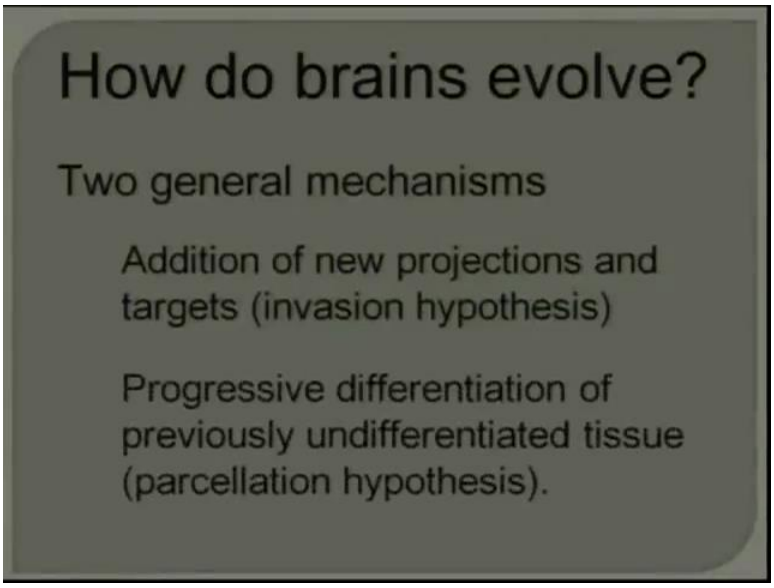

So that two mechanisms one is invasion hypothesis the addition of new projections as I say, and other is that, whatever tissue is there you differentiate in to it.

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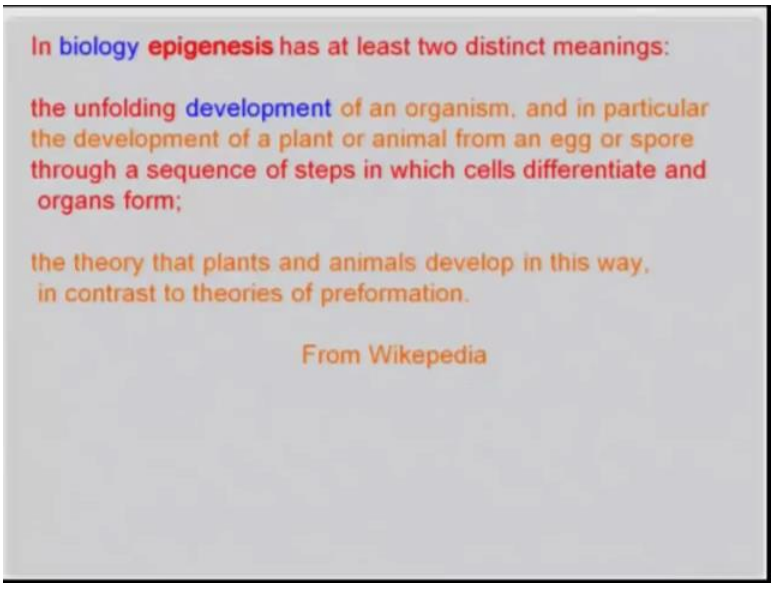

So it evolves in Genetic and Epigenetic, Genetic is the genetic blue print through which it comes, it actually genes unfold, they have about 30000 genes, out of which 50 percent go and brain making The huge number. So at one point of time, it was third rated which is with some people use to call “Tabularize” a blank slate you can write on it. Brain has no temperament of it as own, but then genetics came in and then people believed it is all genetics. But then if it was all genetics, we never find concordance rate. In the sense concordance rate is and if you study twins. Monozygotic twins which are the same embryo, or Dizygotic which have been fertilizer to the same time. Monozygotics have the same set of genes, and then they should have all characteristics as the same. But when you study illnesses, then you never find it 100 percent rate then there must be something else.

So the new concept is Epigenetics, so if you read it carefully; it is the unfolding development of an organism and in particular the development of a plant or animal from an egg or spore, through a sequence of steps. In which cells differentiate and organs form, so they are not Preformation they are not pre formed. It happens every time point, development is a consequence of the confluence of genes and prior experience, which in turn alters the subsequent expression of genes and their interaction with environment.

So again that same old debate of nature and nurture comes in, nature has a blue print. It forms to a certain extent, environment place it role in fine tuning it. So when it comes to brain, it means that the brain organs and the basic networks, the basic number of neurons the basic everything is already genetically modify to this programs. What epigenetic factors modulate it, epigenetic factors may be; even mothers sisters can alter the meiotic and fluid and cortisol level in it. That can cause some mutation, non expression of some gene mother talks in, can do it, trauma, can do it some genetic mutation can do it.

So that case varying the expression of genes, probably that is the source of difference in human beings. When networks are being formed, right from third, first two months of in womb, till the first two three years, when the basic synaptic thing is forming, at that time all the external

influences, and that is the theory behind what we call well being today as mothers to be getting involved in to music and calming things.

So that the networks are healthy and that is a first second third is probably Froud was right when he said that everything is in the child hood. So basic we know that in the first three two years of life, the basic networks are formed and if the environment is not healthy, there is a trauma, that warm can upbringing and every food and nutrition security, everything is not people develop anxieties, those networks are firing it all their life it continuous and then after first two three years till about sixteen seventeen, what keeps happening is that a critical periods. Like one in adolescence, one in.

So environment throws challenges at the individuals. The individual response in that these synapses are in the networks keep changing the shape. Your networks brain is very very plastic. It keeps changing all it is life; even you are old person, when the brain is decaying and so what have been a brain grows, this synapses over grow.

First there is a cell death and all when the brain is growing, the brain over grows then this is a synaptic pruning. But all your life, brain is plastic with all learning and synapses keep changing with reputation of a stimulus. The synapses change but some time what happens the sudden thing also there can be like there is a calamity that trauma itself is change synapses so brain is very very plastic that wise that, is why it is said that the childhood is very important and this critical period if, there is a psychological trauma, there is a psychical trauma, which disrupts this development. People are never able to be free of it, and that is the time when most of the psychiatry illness is get triggered.

In critical period when there is a synaptic pruning happenings (Refer Time: 25:48) one illness will gets triggers on, lot of illness we start in adolescent is basically, when this synaptic pruning is happening.

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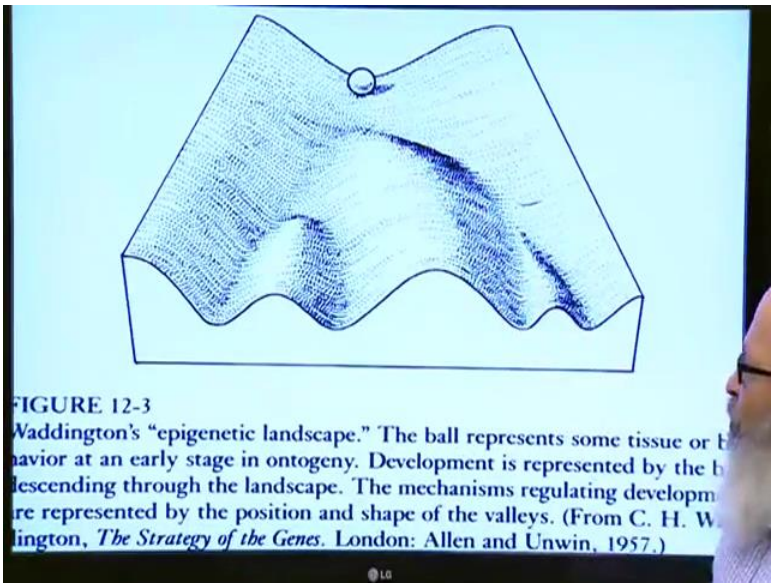

So if you look at this epigenetic landscape, it is like maybe this is some tissue, early in the development and this is the whole landscape in which evolve somewhere this is the sink, somewhere this is the source, this tissue has it is own shape. But eventually what it is going to evolve this, by moving through this landscape.

Now this is broadly (Refer Time: 26:25) so brain evolves on it is own, through this genetic mechanism. But there is a huge effect of periphery that is environment.

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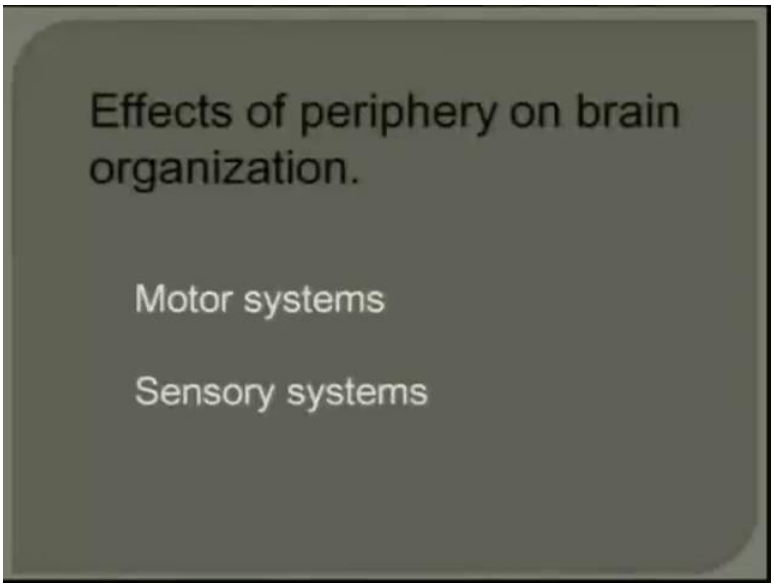

On motor system on sensory system, that is why if you go back to the slide in the last lecture; where I said is it context; our human beings cannot live and like an island; because there whole sensory motor system develops. It is so embedded with an environment and now you can understand; when I say that even when the genes are common, why human beings behave like a similar way. Like all Chimpanzees behave in the similar way why because, their neural system is developed, with almost similar environment.

So mother hood is the same, the maternal affection is the same, the way kids are brought up is the same, we play with kids as the same, the way parental anxiety is the same, way so now you can explain lot of behavior why do father and son always get into tiff. It is half of it is program that anxiety will come in. So teenager fighting with their previous generation, I think it is biological because the teenager is trying to tell it is network it own and dependence at higher cognitive level. The previous generation tries to push it in it is own secure way, because they have got a certain pattern of behavior sensory systems, the same light same foods and same.

So a brain will not respond, unless now if you take a human being, you if you see a film called "Jungle Book" all of you should see.

They are really stories of wolf child. Probably may be at that time because when there were jungles (Refer Time: 28:28) would have see a wolf child because you know people who have seen a wolf child, this kid somehow it was left in jungle and I was almost brought up by wolfs, but some maternal reason and he is started living like wolf and so it was a context. Today also we know that, if there is some pharmacy peoples have developed this nasal spray of a common called "Oxytocin" you pump Oxytocin and we suddenly start getting feeling of warm, then affection and all that. So it is the environment, not only external environment. I am talking of chemical environment also.

So I will ended this and may be the last lecture of this1st week module, we will talk briefly more about this before we really jump on to it.

Thank you.