

Psychology of Personality and Individual Differences: Theory and Applications

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Week 3

Lecture 5: Genetics, Physiology and Personality

I welcome you all to module 3 of this course. So module 3 is about the bio-psychological perspective of personality psychology. So in this module we will be mostly talking about how biological aspects within us contribute to our personality. So today is lecture 5 and it is the first lecture of module 3. So today's lecture is on genetics, physiology and personality- how physiological aspects and genetics contribute to our personality.

So, this will be the focus of our lecture today. So, before we talk about today's lecture let me give you a brief recap of last lecture and what we have talked about. So, in the last lecture and module we talked about personality assessment, in one lecture we introduced the concept of personality assessment and what are the characteristics of a good test and then we talked about more specific methods within personality assessment. So, the last lecture was about specific methods.

So, in that context we discussed certain types or methods of personality assessment. We talked about self-report tests and we gave some specific examples of reliable and valid self-report tests. We also talked about Q-sort test, another kind of test which is also kind of a self-report but requires more active involvement from the participant where the participants themselves sort out the different characteristics within themselves, with more significant to less significant characteristics and so on. We also talked about projective test in the last lecture. The projective tests are based on the Freudian theory where when an ambiguous stimulus is given to a person and they are asked to describe about those situations, they are more likely to project their unconscious desires, wishes, motivations and characteristics into the description of that ambiguous picture.

So, the projective tests are mostly like this. The kind of stimuli that are used in the projective test differs from one type of test to the other. For example, Rorschach test uses ink plots, very ambiguous ink plots. TAT test uses figures of people, ambiguous figure where one can tell a story about that figure and so on. We also talked about clinical interviews and how it is used in personality assessment.

We also talked about different physiological measures which are used in personality assessment. So, these are some of the things that we talked about in the last lecture. So, today we will be talking about the biological aspects of personality. In that context we will be talking about how biology is connected to human temperament which is an aspect of personality. We will talk about some of the early views and we will talk about some of the more contemporary views and at the end we will be talking about how genes and personality are connected- how genes contribute to our personality and so on.

So, let us start today's lecture. Now, to talk about biological aspects of personality, one of the most curious case that is discussed is the case of Phineas Gage. So, that person went through an accident and that gave a lot of insights about how biological aspects contribute to our personality. So, in the study of science, accidents sometimes lead to unexpected discoveries. So, this is one such case.

This is one such incident that occurred in 1848 with the name of a person Phineas Gage. He was a railroad construction foreman. So he was working in the railroad construction work. So on a particular day, in a tragic event when an accident happened, although it is a tragic incident but as a side effect of that incident it gave a lot of insights about how biology is important in understanding human personality.

So during the routine procedure involving explosives, so that was kind of the work that he was doing, an iron rod was propelled through Gage's left cheek, skull and frontal cortex. So, an accident happened during his work when an iron rod went through his cheek, through his left cheek, skull and frontal. So, it completely shattered one part of the face through the brain. I will just show you the picture of this person also. Somehow he miraculously survived that accident, but his personality completely changed.

So, this is the figure of that person. His name was Gage. So, he had kind of gotten very fond of that rod and he was, you know, you can see he was holding that rod in the picture itself. So this is how it happened, the side picture shows how this rod entered through his left cheek, through this part and through the frontal cortex of the brain itself. But he survived.

He did not die in that accident. So what happened after that incident? So before the accident, Gage was described as a serious, industrious and responsible person. So these were the characteristics of him before the accident. However, after the accident, his personality completely transformed.

He became irresponsible, thoughtless of others and lacked planning and consideration from consequences. So his personality completely changed. Whatever the characteristics he had, it became almost opposite to that. So he was very serious and responsible. Now he became completely irresponsible.

Thoughtless of others and he lacked planning, consideration of consequences which was very much there before the accident. So as a person he changed and his personality and character completely changed as well. So this Gage case highlighted the critical role of frontal cortex because his whole frontal cortex, cortex means outer part of the brain and the frontal part, so this part of the brain, frontal part of the brain, because it got damaged in that accident it also reflected that this part was responsible for lot of this personality construct. And because of the damage of this part, his whole personality transformed, and he transformed into a new person.

So this is one incident that shows how certain part of the biology like brain is important in determining your personality. So in that context one particular concept that is studied is called temperament. Now temperament we have already kind of introduced in first lecture, is another term which was used before use of the term personality. And temperament is used more specifically in the context of personality. For example, temperament is usually used to describe the biological aspect of personality with regards to newborn babies. They have no other influences, only whatever genetic composition they have. And you can see these children behave very differently. Some children cry all the time, some children are more placid and peaceful.

So their behavioral differences, from where does these differences come? So this is biologically determined because environment has not influenced yet. So this biological difference in terms of emotional and motivational tendencies seen in individuals contributes to individual differences which are mostly evident in the early part of life or infancy and it is called temperament. So this temperament, it can continue in the adult life also. People differ in the temperament so the typical emotional reaction, motivational reaction pattern and that is called temperament and it is often considered as a foundation of personality and influences how individuals approach and react to the world around them.

So temperament is the initial individual differences, biologically determined that kind of sets the foundation for individual differences. So, this term is more specifically used in the biological context- biological contribution of individual differences. So, this is just a picture where now you can see the differences in the reaction pattern, the emotional

reaction pattern of children. Some are very joyous, some are more peaceful, some are more outgoing. Even in a very initial phase, these differences are related to temperamental differences.

So the early life temperamental qualities include differences in experiencing positive and negative moods. So some children experience more positive moods, some experience more negative moods. So depending on their moods also children can differ which could be biologically determined. Responsiveness to stimuli, some children they are very responsive, they react to stimuli very fast, some react to them very slowly, ability to self-regulate an emotional reaction, how one is able to regulate their emotions. So, all of these differences may be included in the temperament itself. Now, let us see some of the early theoretical understanding or early views of how biology contributes to temperament or temperamental differences in the human personality. So, historically, let us see how it has evolved, how the understanding of this temperament concept has evolved. Let us see some of the historical perspectives. One of the first theory about temperamental differences between individuals comes from the humoral theory proposed by Hippocrates.

Now Hippocrates is known as father of medicine because he contributed a lot in terms of understanding human diseases, human body and medicine and so on. So he is often regarded as the father of western medicine. He proposed a humoral theory of temperament around 400 BC. It is quite long back.

In 400 BC he proposed a humoral theory. And it is considered one of the first theories that talked about biological basis of personality. Now this theory suggests that human behavior and health are determined by the balance of four bodily fluids or humors. So according to him there are four body fluids or fluids that are present within the human body.

There are four typical types of fluids and these fluids determine human temperament or psychological characteristics of the person. Now these four body fluids according to Hippocrates are blood, phlegm, black bile and yellow bile. So bile is basically secretion from the liver end. So there are two types, one is black bile and one is yellow bile.

So we will look at these four. So according to him the balance and the quantity of such fluids present, the extent to which they are present in your body, whether they are balanced or not balanced, they will determine certain psychological characteristics. So according to Hippocrates each of these humors correspond to certain qualities or mental qualities of the person. So let us see what are the qualities he talked about.

So the first one is the blood. So according to Hippocrates blood is associated with air element. So he had corresponded each body fluids with certain elements in the outside world. So he corresponded or kind of associated blood with air element and he believed that blood is produced by liver and associated with worms and moisture so this was his belief and his idea. According to him a balanced amount of blood was thought to result in a sanguine temperament characterized by optimism, sociability and cheerfulness. So according to him blood that is present in the human body is responsible for your sanguine temperament.

If it is present in balanced amount in your body, it will lead to certain temperament or psychological characteristics, and sanguine temperament is mostly associated with cheerfulness. The person will become much more cheerful, optimistic more sociable and so on. So it is associated with positive temperament or mental qualities.

So the first one is blood which is associated with sanguine temperament if it is present in the balanced amount which is characterized by more positive characteristics such as cheerfulness, optimism, happiness and so on. Second is phlegm. This is associated with water element according to him. So phlegm was produced by the brain and associated with coldness and moisture. So according to him it is produced by the brain.

And it is mostly associated with coldness and moisture. The moisture element kind of contributes to the development of this particular fluid. So an excess of this fluid was thought to lead to phlegmatic temperament. Phlegmatic temperament is characterized by calmness, sluggishness and apathy. So if it is present too much in your body then the person will become more calm, kind of lethargic etc. Not much activity oriented but more of a calm, sluggish, apathetic orientation. So this is another fluid that is associated with another characteristic.

The next one is black bile. It is associated with the earth element. Black bile is believed to be produced by spleen, an organ in the body associated with coldness and dryness. Too much of coldness or dryness will lead to production of this kind of black bile. Bile is mostly associated with the liver.

So, an excess of black bile was thought to cause a melancholic temperament characterized by sadness, introversion and pessimism. So, black bile, excess of black bile if it is there in your body, it will lead to more of a melancholic temperament. So, melancholic is a term that is used commonly in the English language to refer to certain depressive characteristics.

So, an excess of black bile will lead to depressive characteristics such sadness, pessimism and so on.

The fourth one is yellow bile which is associated with the fire element and according to his conception yellow bile is produced by gallbladder and associated with worms and dryness. Excess of yellow bile causes choleric temperament which is characterized by irritability, ambition, aggression, mostly agitated characteristics. People in this case become disturbed so easily, irritated, show a lot of aggression. Those kinds of characteristics are associated with yellow bile. So, these are the four body fluids he talked about. It is one of the earliest theories to link certain biological aspects of our body with personality.

So, according to this theory, the balance of these humors was thought to determine individual temperaments. According to the quantity of these fluids in your body, one will have certain characteristics and it will determine the health and illness of the person. Illness or personality imbalances were attributed to excess or deficiency, either excess or deficiency of these body fluids.

So, if they are in the balanced amount, they will lead to a more healthy personality and so on. All contemporary scientists and psychologists reject this theory because there is not much evidence associated with this theory. It was one of the theories which may have some truth in partial aspects. But mostly you know there is not much scientific evidence associated with this theory. So it is discussed in the literature because it is one of the earliest theories to have talked about the biological contribution to personality.

Another kind of study arose in the 19th century by a person named Franz Josef Gall. Franz Josef Gall, he was a biologist and he introduced a field of study called phrenology where he suggested that specific regions of the brain controls distinct emotional and behavioral functions. He said human brain has so many different parts and all of these different parts are associated with different emotional and behavioral functions.

So he tried to identify which part of the brain is responsible for which kind of behavior. But it was not like actually doing brain imaging and so on, at that time it was not there so he kind of made a whole map of the brain and he said that the kind or nature of bumps or outer structure of the skull can give you an idea about which part is more dominant because if certain part of the brain seems to have more area as seen from the structure of the skull that means that part is more dominant, like that he made certain conclusions. So, Gall conducted post-mortem brain examination to correlate brain tissue variances in the individual states. So, he said that the part of the brain which has more tissue, more are as

evident from the skull structure will lead to a different behavior. Accordingly, he said that this person will have this kind of dominant behavior because he associated different parts with different behaviors. So, if particular X area is having more area or is more pronounced in the skull, then that particular characteristics will be dominant in that person. So, this was his idea of phrenology. So presence of bumps in the head was considered indicative of underlying brain tissue development. So what kind of skull structure you have indicates which part of the brain is more developed and so on.

So that was his idea, seeing the structure of the skull and making an assessment of person's personality and so on. So this was an initial photograph of Gall's where he can see the different parts of the brain and say which part of the brain is responsible for what kind of function. So in this picture it may not be very clearly visible but there is another picture which is more colorful. So you can see here that he has associated the different parts of the brain with different behaviors such as cautiousness and so on. So he had these idea based on his observations and so on.

Like this he made an elaborate structure of the skull and which part of the brain is responsible for what functions and so on. So in the 19th century for some time this phrenology gained lot of popularity and lot of people actually believed in it including people who are highly intellectuals and so on. However contemporary research has shown that brain function does not work like that. It is shown that brain's functionality differs from what Gall had assumed, which emphasizes the synchronized activity of the interconnected brain regions for complex cognitive tasks rather than localized function. Brain doesn't work like a localized entity where each part will function only for this particular aspect or behavior.

The brain doesn't function like that where each area will responsible for only particular action and so on. Brain is more of an integrated organ where different parts of the brain are interconnected and complex mental functions are done by different parts of the brain working together and so on. Still there may be some localized functions but it is not like what Gall has proposed that every part of the brain is responsible for different functions. In actuality brain with the recent evidences shows that brain works more in an integrated fashion rather than more of a localized ways.

There is another theory, kind of an early theory where researchers have tried to link certain body types with personality characteristics. So in the 20th century, especially two researchers, they did a lot of research on this. One is German psychiatrist Hans Kretschmer

in 1925 and an American psychologist William Sheldon in 1940 and 1942. They tried to correlate different body types with different psychological characteristics- depending on your body, you will have a different personality type,

Although they use a data oriented, empirical way as compared to phrenology and other things. We will see what kind of findings they have reported. So they conducted a lot of systematic studies actually, carefully measuring body types of lots of people and tried to relate temperament or personality characteristics associated with those body types. So, we will talk about William Sheldon's theory because it is more discussed and is more elaborate and so in that context we will try to understand how he proposed it.

So, William Sheldon he introduced this concept of somatotypes. Somatotypes, soma basically means body and Types means types. So, body types. somatotypes means body types.

So, he said every individual has certain body types. So, he classified typical body types. So, people may be in between that also. But if you see typical categories of body, he said there are three types of body types. One is endomorphs, mesomorphs and ectomorphs.

So, these are the three types of bodies, typical body categories, extreme categories. In between there may be many people also. But these three types of body characteristics are discussed here. So, endomorphs are one category of individuals whose body is round and soft body, round shape. Higher levels of body fat.

So more of a fatty structure of the body. Round, soft, more of a fatty structure. So this is one type of body. According to him Sheldon's theory psychological characteristics of these people or the way they are is that they are more social, friendly and relaxed type of people. So people with this kind of body are more relaxed, more friendly, more social.

Mesomorphs are another type of body types which are muscular and athletic body types. So people who are very muscular, strong type of body. So according to him, this type of people have these psychological characteristics- they are very assertive, competitive, vigorous, a lot of energetic characteristics aspects are there.

So they are very assertive, confident and so on. The last one is ectomorphs. These are people with lean and slender physique, low body fat, minimal muscle mass. So these are more like typical lean and thin type of individuals. According to him, this kind of people are introverted, more sensitive, intellectual type of people.

So they do more mental tasks, very introverted, they are less outgoing, very sensitive kind of individuals. So, according to him these are the typical categories of body types and accordingly they have this kind of psychological characteristics. So, these are the typical depictions of these three body types. So, endomorphs have more of a fatty structure, more muscular is mesomorph and more of a lean and thin, although in this figure it is not that lean and thin but typical ectomorphs are much more lean and thin than what is depicted here. So Sheldon proposed that these somatotypes are linked to these specific temperament traits and behavioral tendency. He suggested that individual with different body types would exhibit different patterns of behavior and personality so this was his proposition what he found from his data also, because he observed, collected, you know measured these body types and then measured their psychological characters and he found these patterns among these individuals. Crash mass theory was also very similar, he used different terminology only but the concept was very similar to this Sheldon's theory. Now, if you see the evidences, you know, lots of later cases, you know, there were a lot methodological problems about how they came to this conclusion, a lot of questions were raised on that.

A lot of subsequent research did not find a very strong relationship between body types and personality. Even if there is a relationship, it is a very weak relationship. So, there is not a very strong evidence that, you know, these body types will all the time be specifically related to the psychological characteristics. Many people also say that it may not be the body types that is causing the psychological differences.

It may be because how other people respond to these people. For example, if somebody has mesomorphic characteristics with a very strong and muscular body, others will also respond to that person in similar ways and because of his strong and muscular body probably he will automatically feel more confident. Others will also respond to that person in the similar way. So he will also become much more confident and assertive.

So many times it may not be the biological body type that is causing the psychological characteristics. The cause could be how others respond to that person. So the causality may not be very directly associated with that. So that could be also another reason why sometimes such connection could be established. And also body types could also change for some people.

Although genetically set certain body types are there but you know lot of time many people also change their body types, sometimes people who are very lean and thin can become fat. Also, obviously it can take time but some people can remain like that in their whole life.

Some people can change their body types also. So there are a lot of issues with such conclusions and it may not be true for every case. Now, let us see some of the contemporary ideas behind this- how biology is related to human psychological characteristics, more recent researches.

So, these are mostly like early researches where evidences are not very clear and not completely accepted. Most of these ideas are not completely accepted based on the recent evidences. So, let us see what are some of the recent evidences available in terms of how biology is connected to certain temperament. So one of the idea that we will be talking here is Jerome Kagan's two types of profiles of individuals.

One is called inhibited and the other uninhibited types of children or types of individuals. So, this is more of relatively recent research. So, this is the photo of the scientist Jerome Kagan. So, he proposed this idea of inhibited and uninhibited types of individuals. What are these?

Let us see. So, Jerome Kagan's research is on temperament, he did a lot of research on temperament. He focused on these two particular types, inhibited and uninhibited profiles of individuals, particularly in the field of developmental psychology, how as the child grows, what is their initial temperament, how it progresses as they grow in their life. So, Kagan conducted a study to test the hypothesis that infant's reaction to novel stimuli predicted their temperament later in childhood.

So initially how an infant after birth or after few months of birth, how they react to outside stimuli, what is the reaction pattern? This will determine the later childhood or even maybe adult personality. How that remains- how initial biological difference of reaction pattern continues in the different stages of life. So he was kind of looking at that idea.

And in that context he did a study. So what he did? He brought 4 months old infants. So these are like just infants after 4 months of their birth.

He brought them to a lab and observed their responses to various stimuli. How they react to different stimuli. He showed different things to them. And how these children react to those stimuli.

According to that he made a profile of these children. Profile of these infants. What kind of reaction pattern they have. So he found one category of children are high reactive. About 20% of them.

So they are very reactive, you know. If you show anything, they will react. Or if you show anything fearful, they will immediately cry. So the reaction pattern is high reactive pattern. So he found about 20% of kids or basically infants here, they are highly reactive.

About 40% are low reactive, means not that strong reaction, you know. They will react but the strength of reaction is very low. So, they weren't influenced much by lot of the stimuli that the researcher showed. And some are mixed reactive means sometimes they react, sometimes they do not react that strongly.

So there is no fixed pattern. They are kind of mixed category. Sometimes they will react very strongly, sometimes they will not react like that. So there is no fixed pattern. So these are called as a mixed reactive about 40%.

Based on their observations... of behavior such as arching of the back, how much they kind of go back by seeing something, how much they cry and so on. So these were the things that they observed in terms of making that profile. So three categories of infant he found, high reactive, low reactive and mixed reactive.

He then followed these infants up to their childhood of 14 months, 21 months, 4.5 years and later up to 8 years. So it was a longitudinal study where for a very long time he observed these children. So, initially 4 months, 1 test, then 14 months, 21 months, 4.5 years and 8 years later. So, at every stage he again measured their reaction pattern whether it has changed or whether it has remained same and so on like that.

So, what he found at each stage or each different stages, the children were exposed to novel stimuli and they again measured and both behavioral observations and physiological measures like heart rate were recorded. So as the infant was a little older obviously other measures were introduced to see their reaction pattern more clearly including their physiological measure like heart rate and so on. Findings shows that most of these infants, actually their temperament or typical reaction pattern continued over time.

It remained almost same. So whoever was high reactive remained as high reactive even at the age of 8. Whoever was low reactive remained as a low reactive kind of a child even at the age of 8. So he found that most of these infants showed continuity in temperament over time. There was not much change in the reaction pattern.

So high reactive infants exhibited greater fearful behavior, the ones who are high reactive they exhibited greater fearful behavior, elevated heart rate and increased blood pressure in response to novelty at 14 and 21 months. So a similar pattern remained even at the 14

months and 21 months which was also captured using other measures like heart rate blood pressure and so on. At 4.5 years, they smile less and talk less during social interactions compared to low reactive. So even at 4.5 years, you know, this high reactive children, they smile less, talk less during social interactions. These children, again, these are some of the other observations, even at 4.5 years.

Their behaviors were inhibited. They were not talking very much to people, they were smiling less, talking less in the social interaction compared to low reactive children. So it is another indication of similar pattern continuing there also. So the majority of the children maintain their initial temperament group assignment from 4 months till later childhood indicating stability in the temperament rates. So it kind of shows that temperamental tendencies at birth remains even in the later childhood also.

So they observe that at least till some initial period of the childhood it seems to remain. So these are kind of more nuanced comparison between these two profiles. So inhibited profile means people who are basically high reactive children in this case. Uninhibited profiles are basically more of a low reactive children that we talked about. So he said based on this reaction pattern two typical categories, some could be mixed also.

But these two typical categories he named them as inhibited profile. Basically, these are high reactive infant that we talked about. Uninhibited profiles are low reactive. So these are the characteristic differences he observed among them.

This is more of an elaborate description. So in the inhibited profile, these children are shy, cautious, timid in unfamiliar situation. When they are in a novel situation, they show more of shyness, timidness. They mostly withdraw from social interaction, avoid new experiences, exhibit signs of anxiety.

On the other hand, inhibited profiles are just opposite to them. They are outgoing, social, adventurous, easily engage with new people and situation, show little hesitation or fear, seek out new experiences. So inhibited profiles also in terms of physiological reaction, they show heightened physiological response of stress. In novel situation, they become highly stressed. Stress reaction is more strong. Increased heart rate, elevated cortisol level.

Cortisol is a hormone that reflects stress level so it is associated with stress. Uninhibited profile, they show opposite characteristics, lower physiological reaction to novelty and stress, less intense physiological response such as heart rate, cortisol level. In the developmental trajectories, inhibited profiles or high reactive children are at a higher risk

of developing anxiety disorders later in their life. But not all of them will develop it, but they are more prone to develop, vulnerability is higher. Tendency for anxiety and withdrawal behaviors, so they have this.

This uninhibited profile, they are also predisposed to seek out new experiences and take risks. Advantages in socializing and exploring new environment, they also have potential risk if not balanced with caution. Such children may also become highly impulsive and have risk-taking profiles in their life. So that may also have certain disadvantages and so on. So they are maybe more vulnerable for those kind of things, highly risk-taking situations and so on.

So these are the two profiles of individuals he found which are biologically oriented. However, this Kagan's research also indicate that childhood profiles are consistent over time mostly. But it is not that it cannot change. There is some evidence that people change also sometimes. There are many high reactive infants which with uninhibited profiles did not remain consistently fearful throughout childhood suggesting that environmental factors also play a role.

Their reaction pattern or fear reaction changed as they evolved in terms of intensity and so on. So that shows environment can also play important role. It is not that it is completely determined by the biological setup. Specifically having mothers who were not overly protective and who placed reasonable demands on them seem to facilitate positive changes in children. So parenting also played role in terms of some personalities, some behavior like fear reaction and so on could also change depending on how they are taught in the environment particularly by the parents and so on.

Similarly, low reactive infants lost their relaxed style over time. Some low reactive children may also lose those styles sometimes based on the environmental effect, indicating environmental influences can modify certain temperamental biases. So there is a tendency that biology sets up, but it can change a little bit based on the environmental influence. It is not like completely set and nothing can be done about it.

It is not like that. Environment can also play an important role. So Kagan emphasized that genetic predisposition to environment are not deterministic and do not dictate an inevitable adult outcome. It is not like it is 100% determined by genes or biology and nothing can be done about it. It is not like that.

There is a pattern which obviously has strength in terms of determining behavior, but certain environmental influences can make certain changes. He also noted that while change is possible, temperamental bias tends to set constraints on the direction of development. So change is possible, but those constraints, biological force that is there within that individual kind of acts throughout their life.

In other words, individual may deviate from their initial temperament but it remains influential in shaping their developmental trajectory. How they grow as a person? That will have a very strong influence. Even that may not be 100% determined but that influence is very strong, the biological influence. For instance, none of the high reactive infants which are inhibited profile, became consistently uninhibited children. So high reactive children did not become completely low reactive. That 100% shift may not happen, but you can change a lot of things. They did not completely transform from high reactive to low reactive individuals. So, it was very rare for low reactive infants to become consistently inhibited.

So, that complete transformation may not happen, but obviously you can change lot of things around it. So there is a certain biological set point that influences you all the time but it is not 100% deterministic. So that is the whole idea behind it. Certain further research also shows like by Schmidt and Fox 2002, they also said certain brain regions are also involved in this profile of inhibited and uninhibited temperament.

Multiple brain regions contribute to these tendencies with interaction among them shaping behavioral tendencies. One important region of the brain they found is called amygdala which is responsible for emotional reaction, it is one small part within the brain. I will just show you the photograph which plays main role in our fear emotions particularly the fear reactions and so on. So, the reaction or what is the activity of this part of the brain will determine this personality profiles of inhabited or uninhabited.

Another important region is the frontal cortex which was damaged in our first case study that we talked about, is also responsible for regulating emotional response, partly by influencing amygdala's functioning reaction. So, frontal cortex is also very important. So, if you see this figure of the brain, so this is the frontal cortex, this is the front part of the brain. Front part is frontal part and there is a small organ somewhere in the center inside the brain and this part is called amygdala and it is responsible for emotional reaction particularly fear reactions.

So these two could be responsible for this personality profile in the brain. If you see the recent researches in terms of how biology contributes to personality, you will find that it

mostly genes which contribute to personality. Now genes, genetics is studied a lot in terms of understanding how they influence personality. So genes play a very significant role in shaping biological traits and behaviors. There is no doubt about it.

Whatever we are as a person is contribution of the genes that we get from our parents. So physical structure is largely about 80-90% determined by our genes. The height that we have, skin complexion that we have, the kind of facial structure we have is all determined by the genetic contribution that we get from the parents. So gene makes the person who we are. So obviously it will also influence your psychological characteristics.

It may not be that strong like physical structure, but it can also influence your psychological aspects, including your personality and so on. So, normally when we talk about genes, just to give you some background, each human cell in the body has 23 pairs of chromosomes. So, total 46 chromosomes each cell has. So, we have, you know... Millions of cells in our body.

Each cell has 23 pairs of chromosomes. In total, 46 chromosomes. The nucleus of the cell has chromosomes. And these are 46 in number. So, 23 pairs.

And out of these 23 pairs, basically half comes from mother, half comes from the father. So, this is how genetic makeup of a person is. Now genes that are found basically these are found in the nucleus of the cells on chromosomes. So chromosomes has genes.

Chromosome that is found in the center of the cell has genes on the chromosomes. So these are basically tiny spaghetti like structures made of DNA. So genes are made of DNA. The number of genes on a chromosome can vary, but a single chromosome can have hundreds to even thousands of genes. Some genes, some chromosomes have hundreds of genes, some may even have thousands of genes depending on what kind of cell it is.

So genes are composed of DNA. Genes are composed of DNA and guide synthesis of protein molecules acting as the source of information. These are like codes or codes of information which determines all the structures, dictates the structures, the kind of protein, molecules, you know, synthesis and so on. So, this is how it sends out those information and accordingly all the things forms.

So, these are more like an information, coded information that kind of directs everything, whatever happens within us. So, this is like this. This is one figure that shows. So, there is a cell and its center is a nucleus and within the nucleus we have chromosomes.

Each cell in the human body contains approximately 23 pairs of chromosomes. These chromosomes are composed of DNA segments, and specific segments of DNA are referred to as genes. Genes carry coded information that influences various biological processes. While genes play a crucial role in determining physical and biological traits, most research indicates that they do not directly cause behavior, particularly in the psychological domain.

There is no single gene that will lead to particular psychological characteristics. Mostly it is polygenic. Instead gene influence personality characteristics indirectly by directing biological function. So gene will influence biological functionings like it will determine the kind of hormones, secretions and internal body organ functions, how they react and so on. They ultimately influence our psychological characteristics.

So a lot of psychological influence that gene have is indirectly through influencing body chemistry and body structure, organs of the body and their reaction patterns and so on. Because whatever happens in the body will influence your mind. So if you have certain neurochemicals in large amount or small amount then it will influence your thought processes like that. So mind and body are strongly connected like that.

So there is a branch of study which is called behavior genetics that looks into this connection between genes and behavior. How gene influences behavior. So there is the whole idea of behavior genetics. It is a field of study that explores role of genetic factor in shaping human behavior and traits. So it tries to understand how both genes and environment interact.

So in that context they also see what extent environment influences our behavior and personality because when you want to study genes you cannot neglect the environment, both contributes to our behavior and personality traits. So behavior genetics looks into these aspects. There is a concept that is central to the idea of behavior genetics, it is called heritability. Heritability is basically the proportion of observed variation in a trait within a population that can be attributed to genetic difference. So, within a population, if you look at a trait, let us say height in a population setup, to what extent the differences in the height in that population can be attributed to genetic reasons.

To what extent gene contributes to the differences in the height of people in a population. So that is the heritability- what proportion or observed variation. Let us say height, we are talking about height. Let us say the variation in the height in a population, to what extent it can be determined by the genes. To what extent gene contributes to that variations in the height within the population. So that is called heritability. So it provides an estimate to the

extent to which genetic factor influence individual differences in a particular trait in a population.

So variations to what extent they can be explained using genetics. So that's heritability. Now one important thing we should understand heritability is population specific not individual specific. So these are population based idea not an individual idea. Heritability concept is not about individual X, to what extent genes contribute that is not the heritability.

Heritability is within the population, the differences to what extent they can be explained using genetics. So heritability does not apply to individuals. It is specific to population being studied. Whatever population, a group of people that you are studying. For example, when we talk about 90% height in a given population is heritable, let us assume this idea that 90% of height in a population, let us say we see a population on a community, let us say.

We are studying a community or let us say a tribal community. And let us say we assume that 90% of height in that population is heritable. That means 90% is explained by genes. What does it basically mean is that you know from that example we can say 90% of the variation of height among individuals in this population can be attributed to genetic factor..the differences in people in the group will be because of genetics.

90% is actually by genetics. It means that if you look at a large population or a group of people most of the differences like how tall they are would be because of differences in the genes. It is because of the genes that we see particular patterns in height. We cannot say that John, let's say particular example of a person in that population height is 90% heritable. We cannot say in that population one person named John, his height is 90% heritable or 90% contributed by gene. It will not be right. Because heritability concept is not for individual person. For the population we can talk about. Not for individuals.

So 90% heritability in a population doesn't mean every individual height will be contributed 90% by the genes. That is not necessary. Another thing, heritability is not a constant value. It can change also. So it varies depending on the population and environment.

So, to what extent something is heritable may change also as the time passes or situation changes in the group. So, it is a statistic applicable to specific population at a particular time and a set of conditions. In that particular time or set of conditions, we can say this is the value of heritability. It can change also later on. Changes in the environment can alter the heritability making high in one population and low in another.

It can fluctuate also within the population. So we cannot say 90% height is determined by genes in every population. Probability is true for one population may not be true for another population. So it can change.

So one of the most important sample that is studied in the genetics is twins.

Why twins? Because twins give a very important, very significant opportunity to study the contribution of genes. So we have two types of twins. One is called identical twins and another is non-identical or fraternal.

So identical twins are 100% genetically similar. Fraternal twins are 50% same like any sibling. These are twins but they look very different. So you might have seen some twins who look exactly same to each other. You cannot distinguish who is who. These are identical twins. They are 100% genetic twins.

Composition is same for each other. 100% same in terms of genetic composition. Non-identical twins, they are twins but they look very different. So these are like 50% same genes like other siblings. So, there are two types, these two types of genes.

So, researchers use this information to understand the contribution of genes and how they influence human behavior and so on. So, these are two main ideas behind why twin studies are done, twin methods in behavior genetics relies on these two logical consideration. One is monozygotic twins means identical twins. Identical twins share identical genetic makeup because they are 100% same in terms of genes. Any difference between them must be attributed to environmental influences.

So if they are 100% same in genes and despite that if you see any differences in their behavior then it should be attributed to environment. Because if genetics is causing behavior that means they are 100% same in genes so their behavior should be 100% same. But if we still see there is a difference in their behaviors, so it should be attributed to environment. Because environment is causing, because genes 100% same. So it cannot be attributed to genes.

This makes the study for genetically identical individuals particularly valuable for understanding the effects of environmental experiences. Second consideration is monozygotic twins are more genetically similar to each other than dizygotic twins. Dizygotic means non-identical who are only 50% same in terms of genetic composition. So, if monozygotic twins are more genetically similar than dizygotic twins, which is the case, if a specific trait is influenced by genetics, if something is influenced by genetics,

monozygotic twins should exhibit greater similarity on that trait compared to the dizygotic twins.

If genetics is determining something, that means monozygotic twins should show more similarity in that because they are 100% same in terms of genes as compared to dizygotic twins. Dizygotic twins basically say another name for non-identical twins. So these are the assumptions based on which a lot of conclusions are made in the studies. So by studying monozygotic and dizygotic twins pairs, researcher can compare their similarities on the trait of interest to determine the extent to which genetic contributes to the observed differences.

Now, only studying monozygotic and dizygotic twins is not enough. Why? If you just study monozygotic and dizygotic twins without considering other things. Now, for example, let us say there are twins who are monozygotic. Now, they are exactly same but the problem is if they stay in the same home, their environment is also same. How do you know this difference or similarities because of gene or because of environment? Because they are staying in the same home, same parent, same environment. It will not be possible to differentiate the effect of environment from the genes because environment is also same, gene is also same. How do you then know whatever behavior is caused by genes or environment?

So because of that the researcher studies a typical type of monozygotic twins who are called as twins reared apart. So they are identical twins but after birth they were separated because of some reasons. It is very difficult to find such samples but researchers have done lot of studies where they could locate such twins who after birth were separated for some reasons. Now their environment is completely different.

They are totally in different home, different environment but genes is same. Now if there is any difference we can say it is because of Environment or and If there is any similarity we can say it is because of the genetic influences because environment is different genetics are not.

We can completely separate it out. So, this identical twins reared in different environment, often due to circumstances like adoption or for whatever reason they are separated, it provides opportunity to researcher to explore how genetics and environment interact. Because these are the ideal people to study the influence of genes on. Not monozygotic twins in the same family. You can get some idea, but because environment is also same, it is very difficult to make conclusions.

But if they are reared in the different environment, and they are still monozygotic twins, then we can have much more clear evidences in terms of making conclusions. So researchers utilize international datasets containing twins separated at birth and raised apart to investigate the influence of biology and social experiences on the psychological development or traits. Studies, many studies have been conducted in that direction. One such study was conducted by Bouchard and his colleagues in started in somewhat 70s and it continued till 1999 around.

It is one of the largest project on twin studies, it included twins which are reared apart. So we will see what they found. So, this is called Minnesota twin study. It is a large project where they studied different aspects of behaviors, intelligence and so on, how it is influenced by genes and environment. So, this is called as a Minnesota twin studies because it was studied in the Minnesota University.

And in 1979, this Thomas Bouchard is the main investigator and with him many other colleagues were there. He started to study, set out to study similarities and differences between twins, both identical and fraternal, who were separated within the first six months of their lives and raised apart. So one specific study included twins who were reared apart. This twin study had many other things also.

This is one specific aspect where they identified twins who were reared apart after sixth month of their birth. Over the course of 11 years, He and his research team collected data on over many pairs of twins which contributed to our understanding of genetic influence on personality and intelligence and so on. So this is one of the most significant and long term broad study. So this particular study where they studied twins reared apart is called as a MISTRA in short form which means Minnesota study of twins reared apart.

This is one particular study in the broad project. So it was led by Thomas J. Bochard and his colleagues. It began in 1970s and continued several decades making it one of the most extensive and influential studies in the field of behavior genetics. So from 1979 it lasted 20 years up to 1999. So this is such a very long project and it included about 137 reared apart twins, 81 of whom were identical or monozygotic twins who were rare depart.

So this is in short form we will say MZA- monozygotic twins reared depart means that they separated after birth. And out of this 56 pairs were fraternal means dizygotic twins reared apart. So both kind of twins were there, who were reared apart means that both after birth were separated. So we can see the influence of both genetics and environment very clearly in all the different conditions.

Monozygotic twins, dizygotic twins you know they also have data for twins who are in the same family, twins who are raised in a different family. So they had all kinds of combination but here more specifically we will see the data of twins who are reared apart. So the main focus was on learning how differences in the twins' life histories were associated with the current differences in their abilities, personalities, interest and health. So they took data from diverse aspects including personality. So a lot of traits were studied, personality dimensions, psychological well-being, achievement orientation, traditionalism, attitude towards religion, politics, so many things, biological data and so on.

So, some of the findings, you know, they looked at the patterns of data, but particular twins were reared apart for both monozygotic and dizygotic twins. The study revealed significant genetic contribution to things like intelligence and some personality traits and even psychological well-being. However, they also found the importance of environmental factors. So, we will see little bit more details about it. So, more specifically, numerous papers were published from this project.

Two particular findings or studies that were reported talked about the individual differences. Two seminal paper that have significantly impacted our thinking on the contribution of genes or behavior genetics. One was about data about personality differences. It was published in 1988 by one of the colleagues of the project who involved in the project- Auke Tellegen.

The first four group of twins study of personality. So it included both monozygotic and dizygotic twins. They are together as well as apart. So they could compare you know. So, monozygotic twins who are reared in the same family, dizygotic twins who are reared in the same family as well as monozygotic and dizygotic twins reared in the different families.

So, they have all kinds of combination. So, they used this multidimensional personality questionnaire to measure their personality. And they found for monozygotic twins the correlations were 0.49, about 50%. Similarity in the personality characteristics of monozygotic twins means identical twins about 0.49 who are reared apart, apart means different families and about 0.51 who are reared together almost same. So environment, it seems very clearly that environment was not really contributing much in terms of their similarity.

Whether they are reared in the same family or reared in the different family, their similarity in the percentages or correlation of their personality characteristics were almost same. 0.49 in case of apart and 0.51 in case of monozygotic twins who are in the same family, reared

together. Similar was the case with the dizygotic twins. Their correlation was less, obviously because they are genetically different. Their similarity was less because the correlation coefficient indicator shows how strong is the relationship and how 0.49 is obviously greater as compared to let us say 0.21.

So, the similarity was more in case of monozygotic twins as compared to dizygotic twins, but the pattern was almost same for those who are reared in the same family or in the different family so environment was not causing much differences in their difference, so genetic was directly contributing to their similarity in terms of personalities so this similarity in correlation between monozygotic twins who are reared apart and who reared together indicated that shared environment not all kinds of environment but family environment does not predict shared personality, suggesting that resemblance in the personality among relatives living together is due to shared genes, not shared environment. So here the gene was really making much more contribution as compared to shared environment, particularly the family immediate environment. So gene was contributing much more strongly.

Shared gene was much more important as compared to the environment in terms of creating similarity in them, in the personality. Obviously here you cannot say environment is not contributing. Remaining 50% is environment and influences attributed to non-shared event. Such as one's unique experiences outside the home environment. Like you know experiences with friends, going outside schools and so on.

Non-shared environment. That also remaining 50% could be contributed by that. So environment is also playing role. Not everything is determined by the genes. So this pattern was almost same with the dizygotic twins, non-identical twins also showing less similarity.

Then obviously the similarity was less in this case because their genetic contribution was less. However shared environment was not playing much difference. These are some more specific traits, some of the traits that they measured in terms of personality characteristics. If you see again mostly it is around 0.5. Except few traits like traditionalism and absorption or imagination correlation was much stronger.

So some traits were little bit higher in terms of similarity as compared to some other traits. But overall you can say it is around 0.5 around that. So this data seems to be different in different reports and so on. But it is around 50%. But some traits are much more strongly determined by genes as compared to some other traits.

So, you cannot say all traits are equally contributed by genes. Some traits, you know, including traits like, you know, here you can see neuroticism is much more strongly influenced by genes. Traits like aggression, traits like traditionalism, these are much more strongly contributed by genes as compared to some other traits. But overall, you can say it is around 50%. The second paper that came out of this project was about intelligence.

So here again they focused on IQ similarity between monozygotic twins reared apart. So this study was part of a series of twin studies conducted in various countries including United States, England, Denmark, Sweden and so on. So they collected data from different countries. So despite differences in the countries, participant investigators and protocols, the IQ correlation among monozygotic twins were remarkably consistent ranging from 0.64 to 0.78 with an average of 0.73.

Monozygotic twins, their intelligence was very strongly determined by gene. It was very clear because the correlation was very high. So, it is we can say around 70 to 73% of individual differences in general intelligence is genetically influenced. So, even at comparison to personality IQ scores or intelligence, general intelligence is much more strongly determined by genes at least this is what these studies reflects. That does not mean it is 100% here again, about 70 to 73%.

Some of the other findings from the other studies, so these are about this particular project findings. So some of the other major findings also shows very strong to moderate relationship or contribution of genes in various personality traits. Like extroversions, we will be talking about these particular traits later in the upcoming slides. So these are the traits. Extroversion is about how much outgoing the person is.

People who like to socialize, go outside and those kind of things. Those are called extrovert. Higher in the extrovert traits. This is again about 50% determined by genes. Some of the study shows.

Other traits like neuroticism. We will be talking more about this. It is more about emotional stability. Some people are more emotionally unstable. So they are more in the score of neuroticism.

People who are more emotionally stable, they are less in the score of neuroticism. Again, it is also again 50% determined by gene, lot of study shows. Activity level is again around 40% determined by gene, some studies show. Some of the psychopathic traits like Machiavellianism, we will be also talking more about them later on. Like people who enjoy

manipulating other people. Ability to manipulate. Some people enjoy manipulating other people. And taking advantage of them and so on. So that trait is called Machiavellianism.

Other trait like cold heartedness. Not sensitive towards other people and so on. Cold heartedness. Impulsive nonconformity. Indifferent to social convention. They don't care about what society thinks and social rules and norms.

Fearlessness. Risk taking and all these kinds of things, characteristics. Blame externalization they always put blame on other people as compared to themselves so these are stress immunity these are some of the traits which are related to kind of psychopathic traits they also show moderate to high genetic influence. Some of the other traits of big five personality traits which we will be talking about later.

Many other traits like agreeableness, conscientiousness, openness to experience. All these are also around 50% contributed by genes. So if you see mostly it is moderate to high influence of genes on various personality traits. So it is clear that heritability of personality is heavily responsible for the fact that personality traits remains fairly stable over time. So you see a lot of this personality traits remain stable over time. People and personalities don't change overnight or after few months or something like that.

An extroverted person remains extroverted for most of their life. So that stability shows strong genetic influence. Again it is not 100%, no research shows it is 100%, but it is very strong data. Even if it is 50%, it is a very strong contribution.

Overall it is clear that major personality traits show modest degree of heritability. Genetic influence is there. In almost all of the personality traits modest means in some cases moderate and in some cases high contribution and so on. So with this I will stop here. So this is all about how genetics and some of the biological aspects are related to our personality.

In the next lecture we will be talking about few more aspects of biological aspects to personality particularly from the evolutionary perspective. With this I stop here. Thank you.