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**Impact of evolution on human thought**

**Testosterone**

For a long period of time humans could not answer the question of what makes a man, a man, and a women, a women. As was recently found main difference is not just in presence of genitals. Probably one will ask why? The answer is that genitals themselves are indirect products of another matter. The name of this matter is testosterone.

“Testosterone is a hormone that stimulates sexual development in male human beings. It belongs to a family of hormones called androgens. Primarily the testicles, a part of male sex glands, produce androgens. The ovaries in females and the adrenal glands in both sexes also yield small amounts of testosterone and other androgens (The world book encyclopedia).”

In its earliest crucial functions, in developing embryo, testosterone play the key role in telling the cells of the genetically male embryo to develop as a male. It is amazing, but all human embryo begins as females for the first few weeks of an embryo’s life, a small group of cells have potential to develop either as ovaries or testes. About one million of genes that are needed to direct the development of a human being, one single gene (the “SRY” gene), which is carried on the Y chromosome, is responsible for determining the sex of the embryo. If the embryo’s cells contain the “SRY” gene, the embryo will develop testes, which at some point and for a limited period of time early in its development produce and release a big amount of testosterone. It turn, testosterone then signal the cells of other parts of the embryo to develop as a male.

As shown in the study by a Stanford research group namely testosterone is responsible for formation of genitals. An experiment was held on newborn female rats. They were injected with testosterone. Surprisingly, but the female rats developed male genitals, and female genitals began disappearing. Later “converted” female rats started revealing purely male behavior, and they were fully aware of usage of their “new” male genitals. The same experiment was performed with male newborn rats. It is amazing, but their penises withered and later completely disappeared. This experiment is not ethical to perform on humans, but random facts suggest that all most the same can be done with humans. For instance, in lesbian couple, butches (female that represents male) use testosterone injections to develop male features such as deep voice, facial hair and muscles (“The He Hormone,” Andrew Syllivan)

In girls, the adrenal glands begin to produce testosterone earlier than in boys. That’s is how and why girls mature earlier, as a rule, than boys. It was testosterone that stimulated the growth of girls pubic hair and underarm hair (there are testosterone receptors in the skin of the pubic area and the skin of the underarm that are genetically programmed to react to testosterone by producing hair). And testosterone stimulated girls skin to produce more oil, contributing to the acne of girls early teenage years, but also to the healthy glow of the skin and the shine of the hair.

The medical book Reproductive Endocrinology by Drs. Samuel Yen and Rovert Jaffe, states; “Testosterone and other androgens have some biological activity o virtually every tissue in the body.” Among the most important functions listed are “anabolic actions, such as stimulation of linear body growth, nitrogen retention, and muscular development.” This statement means that testosterone works to keep the cells of the body functioning efficiently, making the best use of nourishment of growth and maintenance, and particularly contributing to the health of bones and muscles.

Having knowledge of the way testosterone function in the body, artificial testosterone injections can be used for variety of purposes. One of the purposes of artificial use of testosterone is to stimulate sex drive. The balance of this hormone is responsible for initiating and maintaining the production of sperm from early puberty throughout adulthood in male body. During childhood and adolescence, these hormones are responsible for:

1. Growth of genitals
2. Depth of pitch of the voice, increase muscle mass, and growth of bones.
3. Appearance of the body and facial hair.

Overproduction of testosterone caused by testicular, adrenal, or pituitary tumors in the young male may result in precocious puberty. Overproduction of testosterone in females, caused by ovarian and adrenal tumors, can result in muscessation of the menstrual cycle and excessive growth of body hair. Level of testosterone are low before puberty; they begin to increase at the onset of puberty and continue to increase during adulthood. Production begins to diminish at about age of 40, eventually dropping to about one-fifth of the peak level by age of 80 (“Hormone of desire,” Susan Rako). Scientifically established men’s testosterone, level is at least ten times higher than any of the women. According to the last available date, even male population accounts for less than 50 percent of the world’s population, major part of violence is perpetrated by men.

Currently many males use testosterone shots or gel for the purpose of body-building. Testosterone shots trigger imbetterment of appetite and muscles growth. Besides, testosterone can have effects on the function of several brain areas. One additional surprising effect of testosterone is that it can not only affect the function of the brain but also its development and anatomy. Study in laboratory of Roger Gorskis at the University of California, Los Angeles, has revealed that the sex difference in the brain anatomy appears to be due to the presence of male sex hormones at a certain stage of brain development in male rats. Later work has shown a similar effect of testosterone at other brain areas: for example, the spinal nerve cells that control the muscles of the genital area are more numerous in male rats (cross sections through the hypothalamus of a male and female rats (male, (thinner and longer)).

Below is a human life example how hormone level can influence human health, and behavior brought by John K. Young in his book “Hormones; molecular messenger.”

“Bridget was divorcing Bob, her husband of tem years, so she was not terribly surprised when she started to feel anxious and upset upon awakening in the morning. She grew worried, however, when these anxiety attacks became more frequent and stronger, coming upon her at all times of the day. She went to see a psychiatrist. The doctor also assumed the problem was stemming from her divorce proceedings and prescribed an antidepressant. After two weeks of more anxiety and no relief coming from the dedication, Bridget felt like committing herself to a institution. Her nervousness was now even making her hair fall out; her skin began to feel thin and bruised. She was not eating properly either, but was surprised to see she had lost over twenty pounds.

One night Bridget’s best friend Virginia invited her to a dinner party. Over the meal, someone mentioned how traumatic divorce was; Bridget laughingly said that it was not making her thin and anxious, it was also thinning out her skin and hair. One of the other guests, a young woman, asked her to elaborate, and Bridget shyly told her the symptoms she had been suffering from. The young woman then introduced herself as a doctor. She asked Bridget to come down to her office for a few tests. Bridget did and these tests revealed what the doctor had first suspected; that Bridget was not suffering from a psychiatric disorder, but rater a hormonal one. Her thyroid gland was overworking, giving her the symptoms of thinning hair, thin skin, excessive weight loss, and anxiety. Afte4r treatment all of Bridgets’ symptoms disappeared.”

The example described above suggests that level of testosterone influence not only physical development of the body, but also is responsible for emotions and behavior. One researcher, curios about the fact that only male canaries sing during mating season, gave a testosterone shot to female canaries. The result was amazing, the female canaries “burst into song.” The same experiment was performed on zebra finches. Dr. Christina Wang’s study reveals that men with low testosterone level are irritable and aggressive than those with high-normal level. “When their testosterone level was increased during hormone-replacement therapy, their anger diminished and their sense of well-being increased.”

Robert M. Sapolsy, in his book “The trouble with testosterone,” takes opposite opinion side to scientists who think that increasing testosterone level leads to changes in behavior (such as becoming more aggressive). He holds an opinion that changes in surrounding environment trigger change in the level of testosterone.

“Okay, suppose you note a correlation between levels of aggression and levels of testosterone among these normal males. This could be because (a) testosterone elevates aggression; (b) aggression elevates testosterone secretion; (c) neither cause the other. There is a huge bias to assume opinion (a), while (b) is the answer. Study after study has shown that when you examine testosterone levels when males are first placed together in the social group testosterone levels predict nothing about who is going to be aggressive. The subsequent behavioral differences drive the hormonal changes, rather the other way around (“Trouble with Testosterone,” pp. 152).”

It is a good point, but what about evidences suggesting that men after taking testosterone injection find themselves more aggression than normally. The article “The He Hormone” by Andrew Sullivan brings a good example when a man after taking testosterone shot could not control his increased aggressiveness and “had nearly gotten into the first public brawl of his life.”

“Soon after I inject myself with testosterone I feel a deep surge of energy. My attention span shortens. My wit is quicker, my mind is faster, but my judgement is more impulsive.”

 Several other studies suggest that individuals with winning attitudes have higher testosterone levels, at least for a short period of time, than those without such an attitude. One group of researchers, for example, measured testosterone levels in six college tennis players and found that testosterone levels began to rise in all of them before their matches, apparently in anticipation of competition. The big surprise came after the fact: the testosterone levels of those who won their matches remained high, while the testosterone levels of those who lost diminished.

 A second group of researchers, at North Dakota State University in Fargo, undertook even further step by trying to figure out if it was the competition itself, or the mood produced by winning, that caused the rise in testosterone. In their experiment, male college students either won or lost $5 through a series of coin tosses. The task removed all elements of skill or competition; blind luck determined winners and losers. After the tosses had been finished, the researchers measured the saliva of participants for changes in their testosterone levels. Those who won money experienced a more positive mood and a rise in “test”; those who lost whose a decrease in the later. The result suggested that the acts of winning, rather than the nature of the competition or the skill involved, improve mood and produces an increase in testosterone levels. This experiment obviously supports Robert’s Saporky statement that testosterone level changes with external factors.

 Two more recent studies by a single group of researchers went further to find out if one has to directly participate in competing in order to experience increase in testosterone level. In the first study, the researchers measured the salivary testosterone levels of fans who attended a college basketball game. In another, they took the same measurement of a group who watched a World Cup soccer match on television. In each study, testosterone levels were taken before and after the game. In both experiments, those fans whose team had won experienced a surge in their testosterone levels, while those fans whose team had lost showed a drop.

The result was very surprising. Even the fans are not directly involved in the competition, the their testosterone levels change in accordance with whether their team is losing or winning. The supervisor of the researches, a doctoral candidate in education psychology at the University of Utah in Salt Lake City, makes a comment on the researches notes: “Fans do not have much to do with outcome: there are more like voyeurs to the team’s experience of competition.” Nonetheless, experiencing victory even vicariously apparently has very real effect on a person’s hormone levels.

Testosterone level is not only different among individuals, but it changes within one organism one intraday basis. Testosterone level can vary by up to fifty percent during one day. In the mornings it tends to be higher than in the evenings. This is another reason why people feel fresh in the mornings. During the day one might experience ups and downs of testosterone level induced by winning mood effect. These up and downs do not have effect on physical development of the individual (“The Testosterone Syndrome,” Eugene Shippen, William Fryer).

Sensitivity to the changes in the testosterone levels is not very researched subject. It is noticed that different individuals experience different effects after having the same amount of testosterone injected. The genetically determined differences in the numbers of testosterone receptors may be one factor.

Besides stimulating growth of bones, body mass, facial hair, change in voice, testosterone might be a possible reason of illnesses. In the report by Paule A. Lotufo, Joann E. Manson, Alexandersen P, Haarbo J, Christiansen C., on male pattern baldness and coronary heart disease, the authors conclude that “vertex pattern baldness appears to be a marker for increased risk if coronary heart disease. They state that testosterone may provide a “plausible explanation for an association between baldness and coronary heart disease.” The reference cited is a study that shows elevated testosterone levels in men with prostate cancer and baldness; however, these were no measured testosterone concentrations in the data presented. Dr. Brian L.G. Morgan and Roberta Morgan, in their book “Hormones,” are tying to link high testosterone level with coronary heart disease. They bring into attention the fact that in general, since women have lower testosterone levels than men, according to available poll of data, they live longer lives. “Equal numbers for both sexes are around by age thirty, and only 70 percent of men reach age sixty-five, where as 84 percent of women do.”

On the contrary recent results from the Telecom Study showed that decreased testosterone levels were associated with increased cardiovascular risk factors in otherwise healthy men.

Eugene Shippen and William Fryer, in their book “Testosterone syndrome,” agree with the opinion that low level of testosterone are more associated with increased cardiovascular risk factors, rather than all the way around.

“The fundamental fact is this: a clear and ever-increasing majority of medical studies report an association between high testosterone and low cardiovascular disease in men. This is not a coincidental association, since when testosterone is diminished well-accepted risk factors increase, and when testosterone is administered in appropriate doses most of the major risk factors for heart disease diminish. Moreover, in the majority of patients, symptoms and objective EKG measurements improve. These studies are confirming the results I have been getting with patients for years. Men prosper health wise and live longer when their testosterone levels are normal. Heart problems, in particular, are more easily controlled (The Testosterone Syndromes, pp. 81).”

With growing old, men begin experiencing erective problems and losing sexual interest. These problems are caused by diminishment in testosterone level. Facts reveal that men who are taking testosterone, in any form, experience surge of sexual interest, and overall enhancement in physical strength. Eugene Shippen, and William Fryer, in their book “The Testosterone Syndrome,” relate diminishing sexual interest to a sign of future heart disease and diabetes, conditions common in the male menopause (“The Testosterone Syndrome,” pp. 59)

At the end of this research, I would like to notice and bring example of the fact that majority of scientific world hold opinion that artificial testosterone if correctly applied can bring much of good to the human kind, especially to elderly.

“Standford R. is seventy-four years old now, but he has had heart problems since the early 1970s. It did not make life easy for him. He is an athletic man who likes to hunt, fish on the river, and walk in the woods. By the time Standford together with his chest pains, got into the 1980s, it was time for a quintuple bypass. The chest pains started up again in a few years later. His chest pains went away, his energy returned and when he is not walking over the hills and fields and hunting in the woods, Standford makes love. Sometimes twice a day (“The Testosterone syndrome,” pp79).

**Conclusion**

As can be concluded from all researches discussed above change in testosterone level triggers changes in behavioral pattern, and environmental change followed by change in behavioral pattern triggers change in testosterone level.

The arguments in scientific world regarding testosterone and their role in human anatomy are not over yet. The subject is hard to explore, because experiments that has to be done in order to find right answers are not considered to be ethical on humans. The scientific world has no choice, but to use random historical facts to come to the answers. However, the fact the testosterone play a huge role in human development and behavior is not argued by any more.

**Reference:**

1. “The Testosterone Syndrome”; Eugene Shippen, M.D. and William Fryer, M. Evans and Company, Inc., 1998
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5. “Never Too Buff”; John Cloud
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