# Psychological and Physiological Effects of Stress Chiuwen Thor 16 July 2010 Josh Cannon

Abstract:

Stress is defined as the way one handles a demand where the resources is limited. Stress can be categorized into 4 main groups based on its duration and effects. When the body's internal balance is tipped off, the individual undergoes stress. The endocrine system jumps into action to secrete hormones, and the body prepares to fight or flee. High amount of energy is bering metabolized and productivity is maximized. In the long run, however, these high hormonal levels can bring about undesirable side effects: suppression of the immune system, impedement of memory and cell's communication in the brain, and increase in the permeability of the BBB as well as the risk for cardiovascular diseases.

Under a peaceful situation, the body is in the state of homeostasis. The chemical forces are tranquilized and balanced. If this internal equilibrium is not maintained, the individual will experience "stress" ("Renew - stress," 2004). In definition, stress is the way an individual handles a situation where the desired outcome is unclear, and the resources are limited. Stress in and of itself is subjective and differs from individual to individual because the resources available to each is different. A situation can be considered stressful by one but pleasurable by another. Usually, stress is highest for those who consider "winning" as an important but uncertain outcome, and lowest for those who are certain of winning or losing, or do not deem it significant (Subbulaxmi). Research suggests that stress gives rise to and worsens diseases. "43% of all adults suffers adverse health effects from stress" and "75% to 90% of all doctor's visits are for stress related ailments and complaints" ("Stress", 2010)

# **Types of stress**

Stress is classified depending on how long they last and the effects they have on the individual. There are 4 main types of stress: eustress, distress, hyperstress, and hypostress. Eustress is considered the "good stress" as it triggers maximum strength and productivity. It occurs when one needs to be motivated and inspired. An individual experiences this stress when there is need for extra energy for creativity and inspiration. Eustress is the body's driving force when it reacts to fight-flight response ("The Different types," 2006).

In contrast, distress is negative stress caused by frequent, habitual changes that influences the individual's coping mechanism. It can be prompted by anything from a heavy workload to the death of a loved one. It brings about discomfort and unfamiliarity when the brain longs for a standard routine. Distress can further be categorized into acute stress, episodic acute stress, and chronic stress ("The Different types," 2006).

Acute stress stems from demands and pressures of the recent past and the near future. It emerges directly after a change in routine. This type of stress is the most widely recognized and is experienced by most. It can be triggered by the pressure to meet a deadline, or when faced with a financial problem. Fortunately, acute stress doesn't damage the body extensively because it is short-term and can be easily managed and treated. While thrilling in small amounts, acute stress is exhausting in huge quantity. Some individuals suffer from frequent acute stress, a condition known as episodic acute stress. These individuals live in chaotic life where they tend to inflict pressure and demands upon themselves. They are inclined to be pessimistic in their view of the world and believe that disaster is just around the corner. Similarly, chronic stress is constant and can last over the course of months or years. Unlike episodic stress, however, chronic stress is not self-inflicted. Some causes of chronic stress include poverty, dysfunctional families, and unsatisfying career. Sometimes, chronic stress originates from scarring childhood experiences that affect the person's personality. Those who go through chronic stress get used to it and forget about its existence because it is familiar and almost comfortable (Miller & Smith).

The third main type of stress, hyperstress, arises when a person is pushed beyond his or her limit. An overworked person can have a strong, exaggerated emotional response to little things. It builds up a lot of aggravation and anxiety in the person, which usually results in emotional outbreaks ("The Different types," 2006).

Finally, hypostress surfaces when an individual leads a monotonous, unchallenged life. That is, this person lacks stress. A factory worker assigned to a repetitive task can feel unmotivated and restless ("The Different types," 2006).

#### **Stress Response**

The limbic system, commonly termed as the emotional brain, is the primary area of the brain that deals with stress due to its effect on memory and emotions. When one identifies a threat, the limbic system responds through the complex network of endocrine glands that regulates metabolism—the autonomic nervous system ("Renew - stress," 2004). This system is one component of the human peripheral nervous system that functions automatically. It is broken down into the sympathetic and the parasympathetic nervous system. When activated, the sympathetic division triggers the fight/flight response. In opposition, parasympathetic division calms down the activities so that the body relaxes. These two antagonistic systems work together to maintain homeostasis in the body ("The Fight or," 2007).

When the brain senses danger, the sympathetic nervous system is put into work to initiate fight-flight response. The hypothalamus secretes adrenocorticotrophic releasing hormone (ARH) which simulates the pituitary gland to release Adrenocorticotrophic hormone (ACTH). ACTH travels in the bloodstream and prompts the adrenal glands to release stress hormones. The medulla releases catecholamines, such as epinephrine, norepinephrine, and dopamine, while the adrenal cortex releases cortisol. These factors tip off the body's internal balance, and the individual undergoes stress ("Stress: your brain," 2009).

The biochemical alterations prepare the body to fight the incoming threat. Together with catecholamines, cortisol increases heart rate, oxygen delivery to the brain, blood sugar level, as well as dilates blood vessels. The cardiovascular system sparks off and the heart rate increases dramatically. Arteries constrict so that maximum pressure is achieved around the system. The veins, on the other hand, dilate to facilitate the blood in returning to the heart. The lungs, throat, and nostrils open up (Straker).

The fight-or-flight response is a complex phenomenon programmed into the body. When faced with a threatening situation and the individual can choose to combat or escape. Catecholamine hormones aid in the instant physical adjustments for vigorous physical action to come, may it be fighting or fleeing. One effect of the response is the sharpening of the senses. For a better sight, the pupils dilate. For better sensitivity to the surroundings, hair stands on end. This also gives the impression that the individual is larger, a technique for intimidation. Another effect comprises the shutting down of non-vital systems. The constriction of blood vessels to the kidney and digestive system reduces the production of saliva in mouth, and the opening of the bowels and bladder reduce the need for other internal activities. Blood vessels to skin are also constricted to reduce potential blood loss. Sweat glands open, enabling the external liquid to cool down the over-exerted systems. Furthermore, fat from adipose cells and glucose from liver are metabolized to provide an immediate source of energy. The body also releases endorphins to kill pain naturally. Last but not least, the natural judgment system is turned down to be overshadowed by primitive responses. Less time will be spent on analyzing the situation and more bold action will be taken (Straker).

#### Stress and the Immune System

A study at Ohio State University found that stress from watching a violent video lessens our immunity while stress from taking on a memory task activates the immune system (calculated by salivary concentration of SIgA-an immune factor). This proposes challenges from work can have a positive effect on the body's defense system ("Renew-stress," 2004). However, psychological stressors have also known to stimulate the production of CD8 (suppressor T) cells that restrain the immune system (Manuck, et al, 1991). Escalation in adrenaline and noradrenaline can also suppress natural killer cells that attack antigens that invade the body. A stressed individual is more prone to asthma, diabetes, and viral infection because he or she lacks the immunity needed (Glaser, Anderson & Anderson, 1992).

## **Stress and the Brain**

The Blood-Brain Barrier (BBB) is a network of blood vessels, approximately 400 miles long, that permeates the human brain. It brings to the brain nutrients, fuel, and oxygen while taking waste and excess heat away from it. One primary function of the BBB is to shield the neurons in the brain from toxins, viruses, and other contaminants from the blood. Stress increases the permeability of the BBB, allowing chemicals to pass through more easily. This in turn can cause diseases such as Alzheimer's and HIV encephalitis. During the Gulf War, Israeli soldiers took drugs that fend them from chemical and biological weapons. These drugs were not supposed to enter the brain, but due to the stress of the war, 25% of the soldiers reported having nauseas, lightheadedness, headaches and other symptoms that arise when the drug comes in touch with the brain ("Renew-stress," 2004).

Constant secretion of hormones can also impair the function of the brain. Stress triggers the release of gluccocorticoids which can damage the hippocampus, section of brain responsible for learning and memory. Cortisol impacts memory formation and retrieval as it impedes with the function of neurotransmitters which brain cells use for communicating ("Renew-stress," 2004). It travels to our brain and binds to the neuron receptors, causing the neurons to take in more calcium through their ion channels. When neurons are overloaded with calcium, their firing rates dramatically increase, which often kills them (Lovallo, 1997). Additionally, stress hormones avert the sugar in blood to the muscles, preventing any glucose to reach the brain's hippocampus. As a result, the hippocampus does not get the energy it needs to generate new memories ("Renew-stress," 2004). Norepinephrine, too, can alter mental processes such as

cognition because it acts as neurotransmitters in the brain. This leads to poor concentration, mood swings, anxiety, etc ("Stress", 2010).

### **Stress and Heart**

Adrenaline flow from stress can increase the risk of heart diseases. Constriction of coronary arteries when stressed reduces the blood flow to the heart muscle. Aftermaths of the fight-flight response includes high blood pressure and high cholesterol, which in turn cause cardiovascular problems. Stress also contributes to cardiac risk factors from smoking and stress eating. It has been predicted that high cardiovascular reactivity results in greater risk of future cardiovascular diseases (Lovallo, 1997). Catecholamines are linked to hyperlipidemia, hypertension, and myocardial infarction (Goldstein, 1995).

## **Post Traumatic Stress Disorder**

Post traumatic stress disorder is an anxiety disorder developed after a scarring ordeal after the individual is harmed, either physically or mentally. Traumatic events such as natural and human caused disasters, accidents, wars, and sexual assaults can lead to PTSD. Those who suffer from PTSD feel stress even though they are no longer in danger. Short term effects of PTSD include headaches, chest pain, breathing difficulties, and giddiness. In the long run however, the patients live through memory disturbances, depression, phobias, substance abuse, sleeplessness, etc ("Post traumatic stress," 2009).

#### **Stress vs. Productivity**

The relationship between productivity and stress is an inverted "U". Stress can be potentially useful as it keeps the adrenaline flowing, allowing for maximum performance. Stress can motivate a person to accomplish more. As seen on the figure below, stress and performance have a positive correlation up until a certain point, where productivity peaks, and steadily decline thereafter. Both extremes, too little or too much stress, are disadvantageous. This is especially true in the case of the lower end where an abrupt drop on the curve indicates that mounting stress can too overbearing and the person will experience a breakdown. However, the hump, activation and breaking point are different for everyone (Subbulaxmi).



References

- Glaser, W.D., Anderson, K.N, Anderson, L.E. 1992. The Mosby Medical Encyclopedia. New York: Plume.
- Goldstein, David. (1995). Stress, catecholamines, and cardiovascular disease. Oxford University Press, USA.
- Lovallo, William. (1997). Stress & health. Sage Publications, Inc.
- Manuck, S.B., Cohen, S., Rabin, B.S., Muldoon, M.F., Bachen, E.A. Individual differences in cellular immune response to stress. Psychological Science. 2: 111-114.
- Miller, LHM, & Smith, ADS. (n.d.). Stress: the different kinds of stress. Retrieved from http://www.apa.org/helpcenter/stress-kinds.aspx
- Renew stress on the brain. (2004). Retrieved from http://www.fi.edu/learn/brain/stress.html
- Straker, DS. (n.d.). Fight-or-flight reaction. Retrieved from http://changingminds.org/explanations/brain/fight\_flight.htm
- stress. (2010). In Encyclopædia Britannica. Retrieved July 15, 2010, from Encyclopædia Britannica Online: http://www.britannica.com/EBchecked/topic/568921/stress
- Stress: your brain and body. (2009). Retrieved from http://www.youramazingbrain.org/brainchanges/stressbrain.htm
- Subbulaxmi, SSS. (n.d.). Productivity and stress. Retrieved from http://laico.org/v2020resource/files/stress\_jul-sep02.pdf
- The Different types of stress. (2006). Retrieved from http://www.thehealthcenter.info/adultstress/types-of-stress.htm
- The Fight or flight response to stress. (2007). Retrieved from http://olin.msu.edu/thefightorflightresponsetostress.php