

Stress: Its Neurological Implication on Learning

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This post is part of a 4 part series on stress and learning. To see the rest of the series click [here](#).

Standardized tests, bullying, over-stuffed schedules, dysfunctional families, grades, peer pressure, deadlines, personal relationships. The list could go on and on when it comes to naming things that cause stress in a student's life. And what effect does this have on a child's performance in school? What is happening to the brain neurologically when it's dealing with stress and how does this affect memory and learning?

Acute and Chronic Stress

Acute stress, known as “fight or flight,” is for immediate threats and once the threat passes the body returns to its natural state, [homeostasis](#). In a study conducted by the University of California – Berkeley, researchers stated that acute stress “primes the brain for improved performance” (Sanders, 2013). This is what a person feels when they're about to give an important speech in front of their peers. When the presentation is over, so is the acute stress.

[Epinephrine](#) and [norepinephrine](#) are stress [hormones](#) that are produced during acute stress. They also help you think quickly and move fast in an emergency, such as when you're running from a burning building. This is known as [eustress](#) (good stress).

Distress (bad stress) on the other hand, is stress that is prolonged, also called chronic stress. During both eustress and distress, the hormone that is produced is [cortisol](#). The difference is, in eustress, the body returns to its natural hemostatic levels quickly. In distress, because it is prolonged, the

cortisol builds up in the body causing a number of health problems.

What is Happening during the Initiation of the Stress Response?

When there is danger, or when the brain *perceives* there is danger, the body takes action. It makes no difference to the brain if the danger is real or not, it reacts the same way. The [amygdala](#), through the [hypothalamus](#), sends out an alarm to the entire body that it needs to prepare for “flight or fight.” Three major hormones react first. Epinephrine and norepinephrine (also known as [adrenalin](#) and [noradrenalin](#)) sometimes act as [neurotransmitters](#), but they also act as hormones in the bloodstream. They trigger the stress response to take action and they immediately affect the cardiovascular, endocrine, respiratory, nervous, and musculoskeletal systems.

Your heart rate increases, oxygen rises and is pumped to your muscles, palms become sweaty, blood-clotting mechanisms are on stand-by, and your senses become much more alert as your body prepares to respond. The digestive, reproductive and immune systems are not needed at this time so they actually shut down. At the same time, your brain is checking [cortical memory systems](#) to retrieve any information that might be pertinent to the situation (Wolfe, 2010). (“Oh! I’ve seen that red, black and yellow striped snake before! It’s poisonous!”)

Epinephrine and norepinephrine act in a fraction of a second and are secreted for short periods of time. On the other hand, the third hormone, cortisol (secreted by the [adrenal glands](#)), is preparing to keep the brain and body on high alert for minutes or even hours. Being designed for survival, the stress response is well designed to help us through life and death situations.

One of the best descriptions of how stress affects our brain and body was written by a neuroendocrinologist from Stanford University, [Robert Sapolsky](#). In his book [Why Zebras Don’t Get Ulcers](#), he explains that the brain was designed for survival. When a lion and a zebra see each other at the water hole, their bodies actually react very similarly. The only difference is one is

hunting for his supper, while the other is trying hard not to become someone's supper! "On the Savanna, there is three minutes of absolute terror and it's over with... or you're over with" (National Geographic and Sanford University, 2008).

The stress response in both animals goes into high gear. What is happening to the body at this time?

- The lungs work overtime to pump oxygen into the blood stream
- The heart races to pump oxygen throughout the body ... blood pressure is up
- Muscles respond instantly ... lion in pursuit ... zebra trying to save his life by getting away
- What is not essential will shut down temporarily
 - Growth and development stops
 - Reproduction is put on hold... "This is no time to ovulate!" (Sapolsky, 1999)
 - Tissue Repair is suspended
 - Immune System shuts down
 - Appetite suppressed... "Why worry about what to eat when you're about to be eaten?" (Sapolsky, 1999)

When the zebra escapes, the stress response shuts down and it goes back into its normal homeostasis.

But humans turn on the exact same stress response in our daily lives when thinking about "...the ozone layer, taxes, mortality, 30 year mortgages... and we're not doing it for a real physiological reason and we're doing it non-stop!" This prolonged chronic stress is what is causing us problems. And I love it when Sapolsky says that a zebra would never understand why humans turn on the same stress response he does when fleeing for his life, when all we're doing is getting nervous about speaking in public (National Geographic and Sanford University, 2008).

In today's society if we get all stressed out while driving in traffic, our bodies trigger the stress response and it's no wonder stress is considered the [#1 killer](#). As mentioned, when someone is in this state of mind, the [immune system](#) shuts down and why should we be surprised to learn that stress gets us sick.

How Emotion Affects [Retention Rates](#)

Whether or not the brain pays attention to any new information is strongly influenced by the emotion associated with it. Remember, the brain is designed for survival and the [thalamus](#) and amygdala ensures that we react quickly to emotionally relevant information (Wolfe, 2010). In potentially dangerous situations, the event usually has enhanced memories, with extra vividness (LeDoux, 1996). We remember emotional events much more vividly than other events because of our stress response. Teachers should try and put some “emotional hook” into every lesson. Students will have a much better chance of retaining this information.

Memory and the [Hippocampus](#)

In a study conducted by the University of California-Irvine found that when cortisol reaches the hippocampus, the [dendritic spines](#) (areas of the neuron responsible for transmitting information from one neuron to another) disintegrate rapidly. And there is a problem of consolidating [short term memory into long term memory](#). Learning occurs when neurons repeatedly are activated across their [synapses](#). But if there is too much cortisol in the system, memory is impeded (University of California-Irvine, 2008).

“In the classroom, a student can perceive even a mild stressor to be threatening, initiating the stress response and lessening his or her ability to perform” (Wolfe, pg. 141, 2010).

When a person experiences [prolonged stress](#), the brain repeats the same responses, which causes the [neural pathways](#) that controls [anxiety](#) and stress,

to become stronger and stronger. The brain is actually teaching itself to escalate the stress response. This can become a vicious cycle. Not only is the response system heightened, but prolonged stress “short-circuits other neural pathways in the [prefrontal cortex](#)” (Levy, 2014). Attention, creativity, flexibility, self-control, memory, critical thinking and reasoning skills are all essential for successful learning and these executive functions are hindered because of prolonged stress (Levy, 2014).

Conclusion:

When we take a look at the stress response we understand why it was designed that way – for survival. However, as man has evolved over time, we see that our stress response needs to be controlled so chronic stress doesn't take over and destroy our health.

Teachers in particular need to understand how stress can affect a student's learning and memory. [In the next part of this series on stress, I'll list ideas of how they can work with their students to develop stress coping strategies.](#)

For comments and/or questions, please don't hesitate to contact me at DrLou@meteoreducation.com

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In [Part I](#) we examined what was [neurologically](#) happening to the brain while under stress. We now understand that stress impedes learning and interferes with [memory retrieval](#). So what can we do about it? The following is a list of suggestions on how teachers can help their students cope with stress.

Reducing Stress in the Classroom

- **Students need to understand what stress is and how to cope with it**

Making them aware of how to recognize stress in themselves and in others will help them handle the situations much better.

- **Every student needs an adult that they can trust and rely on**

Developing a positive student/teacher relationship is critical for reducing stress. For [children at-risk](#) they need someone that has a calming and empathetic presence that they can go to when in need, such as a homeroom teacher, the school psychologist, the school nurse or resource teacher.

- **Teachers need to allow for social connectivity within the classroom**

[Matthew Lieberman](#), social psychologist and neuroscientist, in his book, [Social: Why Our Brains are Wired to Connect](#), states that just like our need for food and shelter, we have the need to form relationships and to connect to other human beings. That's why we want to develop loving relationships, fit into a school, cheer on a sports team and even check our Facebook pages. Developing a classroom culture of "All for one, and one for all," benefits the entire group as well as each of the individuals within that group.

Teachers need to keep this in mind when developing their lesson plans. Feeling socially connected, in a safe environment, helps build relationships. “Tend-and-befriend” (Bergland, 2013) is the exact opposite of “fight-or-flight.” Having good social relationships increases [oxytocin](#) and actually reduces [cortisol](#). Face to face relationships are the best, however, “phone calls and even Facebook can reduce cortisol if they foster a feeling of genuine connectivity” (Bergland, 2013).

- **Teach [time management](#)**

When people are organized, they have less stress. Allow students to have flexible due dates on assignments. This will lower their anxiety about due dates as well as keep them motivated and on top of their work (Smith, 2013).

- **The importance of acknowledging student effort**

Recognize the student’s effort by either by giving them a grade for their effort or providing extra points. This encourages students to take risks and persevere.

- **Teach [mindfulness](#)**

Developing moment-to-moment awareness of one’s surrounding environment will help the student focus on the current activity as well as reduce anxiety and help improve their coping experiences in the future.

- **Allow for individual needs**

For especially high-anxiety situations for some students, reduce the tension. If a child doesn’t like reading orally, only call on them when they know the passage and are well prepared. To help with test anxiety, have an adult (teacher or aide) help those students that prefer to have the questions read to them.

- **Include physical activity within the school day**

I am alarmed to see how many schools are cutting back (or completely eliminating) their recess time. Nothing could be worse for child development. When I was a child we had physical education class every day and now children are lucky to have it once or twice a week. Not only is the human body developing during childhood and therefore needs this type of activity, stress can be greatly decreased with physical movement. Even taking the class outside for a short walk will reduce anxiety.

- **Keep humor and laughter in the classroom**

A good laugh has many effects. Not only does it “lighten your load mentally,” (Mayo Clinic, 2016) but it also affects your body. It activates and then cools down your [stress response](#), thus giving you a relaxed feeling. Laughter releases [dopamine](#) which reduces stress and increases memory (Mayo Clinic, 2016). Students love to hear personal stories pertaining to things that happened to their teachers when they were students. This also strengthens the bond between them.

- **Lessons should strive to reach that deeper learning level**

[Authentic performance tasks](#) and [project-based learning](#) actually deepen the student’s understanding on both the factual and conceptual levels. If the teacher’s goal is simply test preparation, students may have a difficult time applying what they’ve learned to novel questions or problems. This is why [deeper learning](#) is one of the best test preparations a teacher can actually provide to help reduce anxiety.

“When students experience their learning as personally meaningful, their [intrinsic motivation](#) strengthens long term, durable memory networks. These are far more accessible for test retrieval (and long-term access) than rote memory” (Willis, 2017). Making the lessons and information meaningful to the students enables the brain to effectively

store these memories thus making them easier to retrieve.

- **Create a “mental suitcase”**

Judy Willis, neurologist and classroom teacher, recommended that students could reduce stress and increase their memory by taking a sheet of paper and writing the most important items, formulas, procedures, vocabulary, etc. as a review. Doing this right before taking the test will “... increase their retrieval efficiency when they’re not trying to hold that important information in working memory throughout the test” (Willis, 2017).

- **Visualize a successful performance**

Just like Olympic performers, athletes mentally visualize the physical movements they’re about to perform. This activates critical motor brain networks. Not only does this activity reduce stress, it increases confidence and “preheats” the memory circuits they’ll want to access (Willis, 2017). Have the students visualize how great they’re going to do on the test... have them picture how they’re going to remember important facts and answers making the experience a very successful activity.

Conclusion:

Stress hijacks the brain when it comes to learning. Therefore, teachers need to be aware of the stress their students are experiencing in the classroom as well as in their personal lives. Although we have little control of what happens outside the classroom, we can provide the support and help they may need to handle these stressful times. By understanding how stress affects learning, teachers can help build their student’s [emotional resilience](#) as well as activate their highest levels of [cognition](#).

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