

Brain Morsels: Packet 2



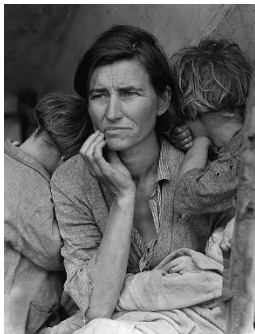
EACH BRAIN MATTERS
THE CENTER FOR NEUROSCIENCES FOUNDATION

On the matter of **chronic stress**

In the last packet, we introduced the topic of stress. We described how the brain alerts to some sort of threat and orchestrates a response that we all have learned is meant to prepare us for fight or flight – figuratively at least. This is especially great, as neuroscientist Robert Sapolsky explained, if you are a zebra running away from a lion. It also works quite well when we humans are under acute stress. BUT....

“Oh my, this is going on and on.”

Chronic stress



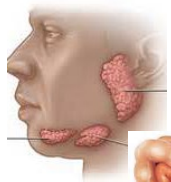
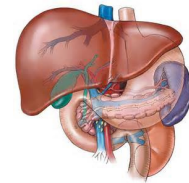
Depression era migrant mother: Dorothea Lange
Tornado damage in Joplin: Britannica
North Korea famine: flickr.com
War and child rubble: scrapetv.com

It’s not just physical stressors, like a disease, or a bad accident with a long recovery time, or famine, that affect us either. Chronic stress can have an enormous psychological component, too. Loss of control (even belief in control helps), the absence of outlets for frustration, a lack of predictability, a perception that things are getting worse – all can make stressors even more stressful.

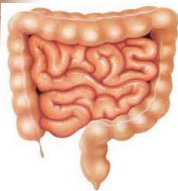
So, what happens when you are under chronic stress? Remember from the last packet that the brain directs a complex response to the presence of stress. When that stress is prolonged, especially if it is intense, the sympathetic nervous system becomes over-active. Ongoing



adrenaline release yields increased heart rate and increased blood pressure that over time lead to sustained high blood pressure and atherosclerosis. Prolonged activation of the hypothalamic-pituitary-adrenal system means lots of cortisol is present. Cortisol normally enhances energy mobilization, but the energy stores become depleted over time. Fatigue sets in. In some people, blood sugar and cholesterol levels rise well above the normal range and excess body fat develops around the waist.



Activity in the parasympathetic nervous system, which normally controls basic body functions, decreases chronically. The result? Less saliva and less overall gut activity so food processing is harder and overall nourishment suffers. Decreased blood flow and reduced immune system function, along with decreased mucus production can lead to ulcers in the GI tract.



Sexual problems also can appear, including impotence and loss of libido.



Bone mass can decrease, bringing greater susceptibility to fractures and slower bone repair. The immune system, which under acute stress is transiently stimulated, now declines significantly. That increases risk of infection and auto-immune disorders.

And finally, **what about the brain?** Well, compromised blood flow can reduce oxygen and glucose delivery to the brain. That's never a good thing as the brain normally requires about 25% of the body's glucose and 20% of its oxygen. But in addition, high cortisol levels, which are absolutely helpful in the event of an acute stress event, now cause damage. Cortisol reduces glucose storage in neurons and their support cells (glial cells) leaving them more susceptible to damage. Higher levels of excitation in neurons can damage them, in the worst cases even to the point of death. Most of the time, sustained exposure to high cortisol damages the branches of neurons and that in turn reduces the number of connections (synapses) between neurons. Thinking slows.

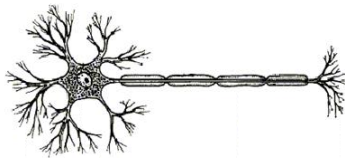
It turns out that neurons in an important memory region called the hippocampus are especially susceptible to high cortisol levels. In humans, new neurons are born at a low rate throughout adulthood but apparently only in the hippocampus. Under chronic stress, fewer new neurons are born. Memory can suffer! Other regions negatively affected are important in controlling impulsiveness, understanding of the meaning of a situation, maintaining attention, exercising judgement, and controlling emotions. Anxiety and fear increase. Many people become less interested in things they normally find pleasurable. Some become less adventurous and may even avoid social interactions.

Good heavens, you say! What can be done?

Stress is inevitable in our lives. A certain level is actually helpful, but prolonged high-level stress is certainly not. The aging process can be very stressful, with loss and significant requirement for caregiving often at its core. Resources may be limited. Though we are sure you have heard it many times, taking care of yourself is critical, as is developing resilience. The American Psychological Association defines resilience as “the process of adapting well in the face of adversity, trauma, tragedy, threats or other significant sources of stress.” In another packet in this series, we will talk about resilience and what we can do to increase it.

Activity: In the meantime, consider your own situation.

1. What are the current stressors in your life, particularly ones that have been especially stressful over a long time?
2. What is your typical way of handling stress? Do you tend to ignore as much as possible or are you a data seeker? Whichever way, has it been a good strategy?
3. Do you have a network of friends and family available?
4. How well do you take care of yourself? Do you get enough sleep, nourishment, exercise?
5. You have a lifetime of knowledge and experience, all stored in your brain. You can use that to construct stronger or new ways, or to find resources that can be helpful.
6. What resources do you have or do you know someone, or an organization, that might be able to help you find what you need.



And on a lighter note.....

Chocolate anyone?

I bet as mid-February rolls around you have one thing on your mind – chocolate. Or, maybe love? Nope. Chocolate! Ah, what is it about that perfect piece of chocolate that makes you want to purr with delight? And, since this is a neuroscience blog, what is the scoop on chocolate and the brain? Why do some people crave chocolate so much that nothing else will do?

Scientists have studied cocoa and chocolate for years in search of answers. I imagine that involved eating a lot of chocolate! They have identified over 300 chemicals in cocoa products, some of which have the potential to be neuro-active. However, these compounds are present in tiny amounts and once eaten, it is difficult to know how



much of each reaches the brain. Compounds studied include tryptophan and serotonin - associated with feelings of relaxation; caffeine and theobromine which act as neural stimulants to increase alertness; phenylethylamine which promotes brain release of dopamine which is associated with pleasure. As always, there is that contingent of scientists that find cannabinoids

hold the key to everything. They theorize that either cannabinoid-mimics or agents boosting release of brain-produced cannabinoids produce the pleasurable effects of chocolate. In related studies, eating chocolate prompts brain production of natural opiates that dull pain and increase feelings of well-being.

Sounds good, but the truth is that many fruits and vegetables contain compounds similar to those in chocolate. You won't find people giving out broccoli or onion hearts as a treat to their special someone, though! So, it may be unique chemical combinations that give chocolate its special edge even over sweet treats like caramels, suggesting it is not just sugar, fats and dairy in some chocolates that make them crave-worthy.

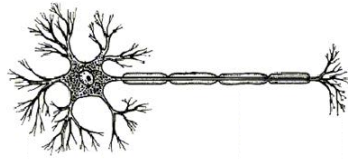
Setting aside the feel-good aspect, does cocoa or chocolate actually benefit human brain function? Several studies have focused on potent antioxidant and anti-inflammatory agents (flavanols) in cocoa products. These have known benefits for cardiovascular health. However, their effects on cognition and behavior are unproven. When you eat chocolate, flavanols accumulate in brain regions involved in learning and memory, especially the hippocampus. Their neurobiological actions are thought to occur via increased expression of proteins which enhance neurogenesis, neuronal function and connectivity, and via improved brain blood flow. Protective effects of long-term flavanol intake on cognition, behavior, and age- or disease-related cognitive decline are seen in animal models of aging, dementia, and stroke.

Unfortunately, few human studies can corroborate these findings: A 2017 review of multiple studies on the subject found some showing better memory performance in people taking high flavanol cocoa supplements for 3 months. Other studies demonstrated improved brain blood flow, oxygenation, and neuronal function in the brain after consumption of cocoa drinks, but the changes were often not associated with improved performance on cognitive tasks. The authors concluded that studies so far have been small, sometimes show contradictory results, and do not control adequately for other variables that may affect outcomes.

So, it will take more than the evidence we have now to establish that chocolate can truly preserve or improve brain function. How disappointing for those of us who are anxious to accept any suggestion that eating more chocolate is healthy for the brain! Oh well then, it is back to exercise, healthy diet, good sleep and not stressing out. Hmm, where did I put that chocolate bar?

Post by: Nadia Fike

Read more: **1.** Brain Cannabinoids in Chocolate, *Nature*, August 22, 1996, pp. 677-678 by diTomaso, E et al.
2. Enhancing Human Cognition with Cocoa Flavonoids, *Front Nutr.* 2017; 4: 19. By Socci, V et al.




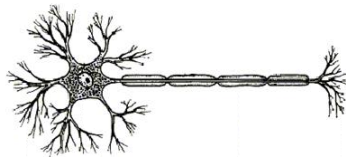
Activity

In preparation for our discussion of sleep in the March packet, please keep a sleep journal for at least a week; longer would be better. The goal is to determine sleep patterns and conditions that affect your sleep. The journal will be for your own use only and will not be

submitted anywhere to anyone. You can find the *sleep diary* published by the National Sleep Foundation in the Appendix at the end of this book.

Add to your journal whether you dreamed. As you think about your sleep and document it, consider how the quality of your sleep might affect your resilience and your creativity.

The National Sleep Foundation is a terrific resource for information about sleep, the importance of sleep to our mental and physical well-being, and tips for better sleep. Check it out at this link: <https://www.thensf.org/sleep-health-topics/>



Sleep and the brain

Sleep that knits up the ravell'd
sleave of care,
The death of each day's life,
sore labour's bath,
Balm of hurt minds, great
nature's second course,
Chief nourisher in life's feast.
Macbeth (2.2.46-51)

Puzzles

Puzzle 1

Get a dollar bill and a quarter (this is not as easy as it once was, we know!). Your job is to balance the quarter on the edge of the dollar bill.

Puzzle 2

Suppose you have 2 large containers, one holding 5 gallons and one holding 3 gallons. You need exactly 4 gallons. How can you do this? (No fair saying go buy a 4-gallon container!)

Puzzle 3

The Brain

W	E	C	R	T	M	N	E	I	V	O	B	M	D
T	G	O	N	C	R	E	E	M	E	E	E	U	U
R	D	N	N	A	T	G	C	M	N	E	I	I	E
C	E	H	E	C	H	E	E	T	T	B	N	N	R
E	L	L	C	R	I	N	R	L	R	M	T	A	F
R	W	B	O	K	N	I	E	N	I	E	E	R	I
E	O	D	R	R	K	U	B	E	C	D	L	C	G
B	N	A	T	A	L	S	R	R	L	U	L	E	I
E	K	L	E	P	I	O	U	V	E	L	E	H	E
L	K	P	X	S	E	N	M	E	K	L	C	C	B
L	E	E	L	U	E	C	R	M	E	A	T	Y	B
U	R	B	N	M	O	B	O	E	E	M	E	S	Y
M	R	E	B	N	L	R	O	G	S	T	P	P	E
C	E	E	C	D	A	R	R	L	E	U	S	E	D

NERVE
PSYCHE
LEARN
STEM
MEDULLA
BRAIN
CEREBRUM
KNOWLEDGE
CEREBELLUM
VENTRICLE
FREUD
GENIUS
INTELLECT
CORTEX
EGO
LOBES
THINK
CRANIUM

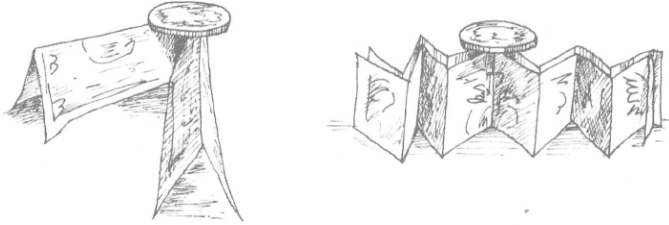
<https://thewordsearch.com>

Answers on the following page

Answers

Puzzle 1

Here are a couple of possibilities.



Puzzle 2

Fill the 5-gallon container and pour as much of the contents into the 3-gallon container as you can. That will leave 2 gallons in the 5-gallon container. Then, empty the 3-gallon container and put the two left in the 5-gallon container into the 3-gallon container. Fill the 5-gallon container again. Now use it to fill the 3-gallon container. Because only 1 of those gallons will fit in the 3-gallon container, the amount remaining in the 5-gallon container is 4 gallons!

Puzzles 1 and 2 come from *The Book of Think* by Marilyn Burns, Boston, Little Brown and Co., 1976