Dopamine – Fuel to Heaven or Hell

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A disciplined mind leads to happiness
And and undisciplined mind leads to suffering
Dalai Lama

The Neuroscience of Dopamine and Addiction

- The Role of **Dopamine**
  - Sensitization
  - Desensitization
- **Hypofrontality** – Not a good thing
- The Marriage of **Triune Brain therapy** and **Polyvagal Theory**

It’s just Fun!

- Many young people accidentally discover pornography, many others are introduced to it by another person, usually a peer or a sibling.
- And indeed, they find it tantalizing and fun.
- They are not seeking to avoid pain nor are they necessarily suffering from a loss of connection to good living.
- So, what starts off innocently enough, ends up changing their neurology and they “accidentally” become hopelessly addicted

The Neuroscience of Addiction

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  - Sensitization
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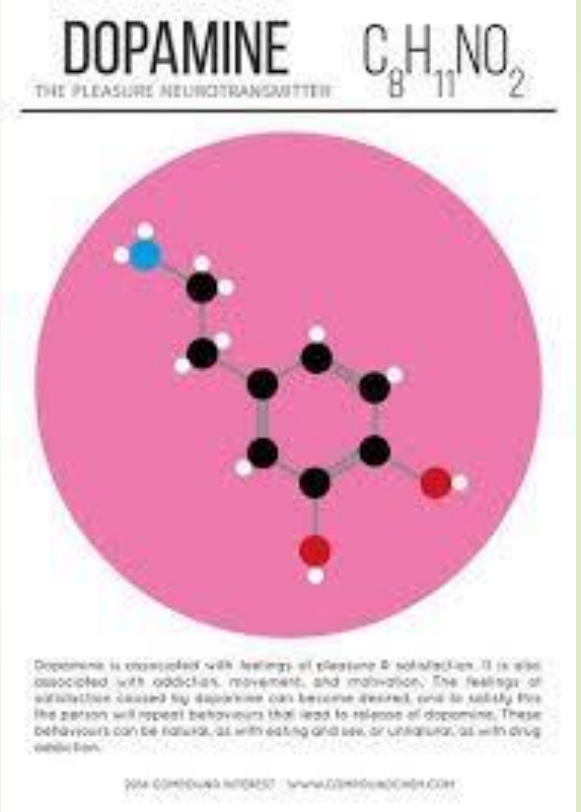
How the Brain Gets Hooked on Digital Drugs

- As Kardaras(2016) stated in his book, *Glow Kids*, in order to fully understand addiction, we need to understand the brain's reward system and the impact of dopamine on that reward pathway.

- Specifically, how much dopamine is activated by a substance or behavior is correlated directly with the addictive potential of that substance or behavior.

- **Dopamine,** as many of us know, is the "feel-good" neurotransmitter that is the most critical and important part of the addiction process. Dopamine was discovered in 1958 by Arvid Carlsson and Niles-Ake Hillarp at the National Heart Institute of Sweden.



Functions of Dopamine

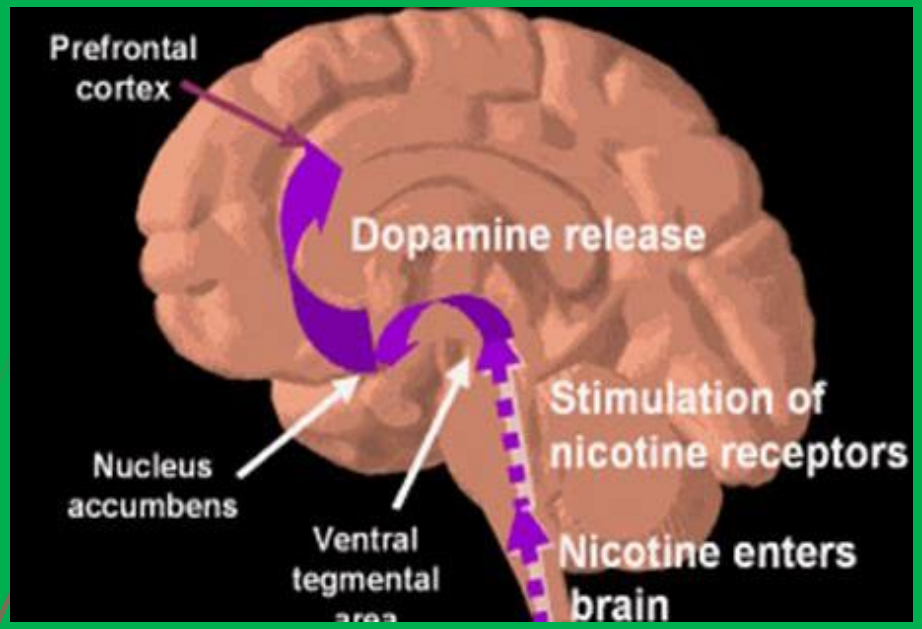
➨ Dr. Susan Weinschenk (2009) noted that **dopamine** is created in various parts of the brain and is critical in several brain functions to include:

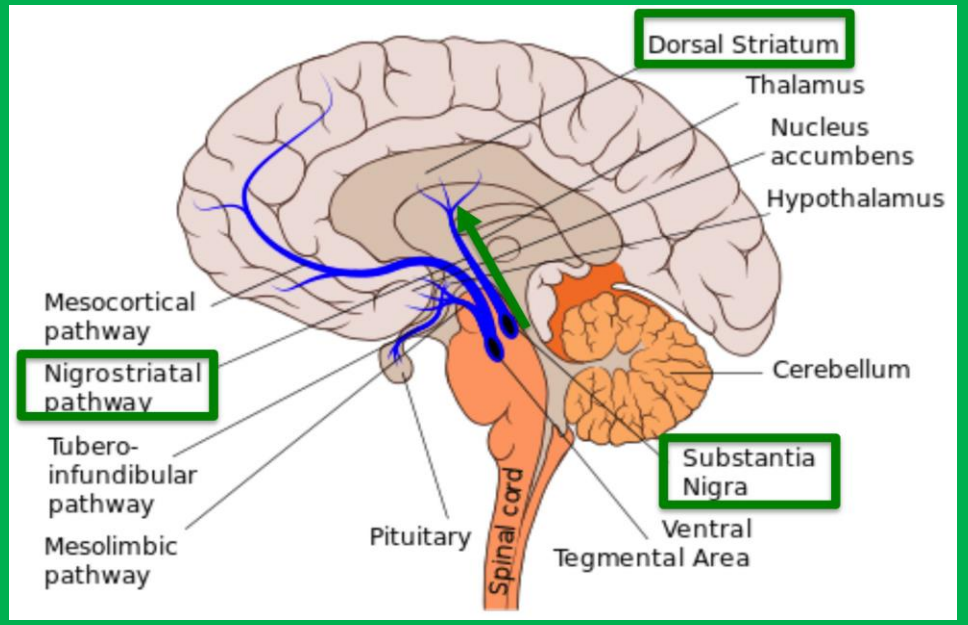
- Thinking
- Moving
- Sleeping
- Mood
- Attention
- Motivation
- Seeking and reward

Inspired to watch because of Dopamine

Two Main Dopamine Reward Pathways

Mesocorticolimbic for motivation and reward
Nigrostriatal for movement





The Mesocorticolimbic Pathway transports dopamine from the VTA to the nucleus accumbens, amygdala, and prefrontal cortex. The nucleus accumbens is found in the ventral medial portion of the striatum and is believed to play a role in reward, motivation, desire, and even the placebo effect.

The Nigrostriatal Pathway travels from the substantia nigra to the striatum. The nigrostriatal pathway is important for facilitating movement.

Dopamine is both a neuromodulator and neurotransmitter

- According to Stanford neuroscientist Dr. Andrew Lieberman, dopamine is both a neuromodulator and a neurotransmitter. The main difference between neurotransmitter and neuromodulator is that a neurotransmitter is a chemical messenger released by a to affect either one or two post-synaptic neurons or another specific effector organ whereas a neuromodulator is a chemical messenger released by a neuron to affect a group of neurons or effector organs with a specific receptor.
- Furthermore, a neurotransmitter directly affects the postsynaptic partner to produce a quick, rapid effect while a neuromodulator indirectly affects the post-synaptic partner, especially through a second messenger to produce a slow but long-lasting effect. Dopamine can be released locally or volumetrically (a large dump). When it is released volumetrically, it affects many neurons. Very concerning, dopamine can ultimately affect gene expression according to Dr. Lieberman.

Click here to listen to Dr. Lieberman's excellent lecture on dopamine: https://www.youtube.com/watch?v=QmOF0crdyRU&t=2s&ab_channel=AndrewHuberman

More on Dopamine

- When an individual performs an action that is satisfying to a need or fulfills a desire, dopamine is released into the nucleus accumbens, a cluster of nerve cells beneath the cerebral hemispheres that are specifically associated with reward and pleasure. This is also known as the brain's "pleasure center."
- Natural dopaminergic activities, such as eating and sex, usually come after effort and delay and serve a survival function.
- These are called the "natural rewards" as contrasted with addictive chemicals/behaviors (which can highjack the same circuity).
- Addictive drugs and behaviors, such as gambling and video gaming, actually offer a short-circuit to this process which only ends up flooding the nucleus accumbens with dopamine and does not serve any biological function.

Bought the BMW but still wanting the Ducati Diavel

Dopamine and DeltaFosB “Keep doing it!”

- Highly salient activities, in this case addiction, lead to the accumulation of DeltaFosB, a protein that activates the genes involved with addiction. The molecular changes it potentiates are almost identical for both sexual conditioning and chronic drug use. Specifically, DeltaFosB rewires the brain to crave IT whatever IT is.

- In a sense, dopamine is like the foreman on a construction site barking orders and DeltaFosB is the worker on the site. Dopamine is yelling, “This activity is really important, and you should do it again and again.”

- DeltaFosB is responsible for ensuring that you remember and repeat the activity.

- This repeated process produces what is called sensitization which is based on the principle, “Nerve cells that fire together wire together” as noted by Canadian researcher Donald Hebb in 1949. Repeated activity strengthens cell connections.

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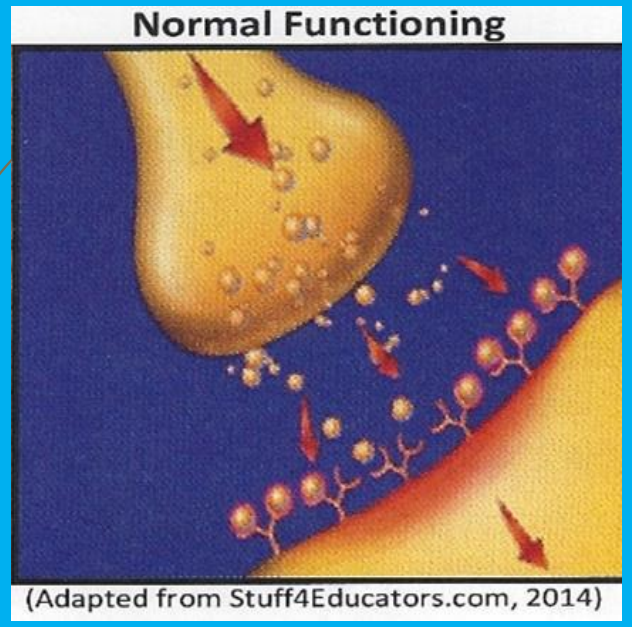
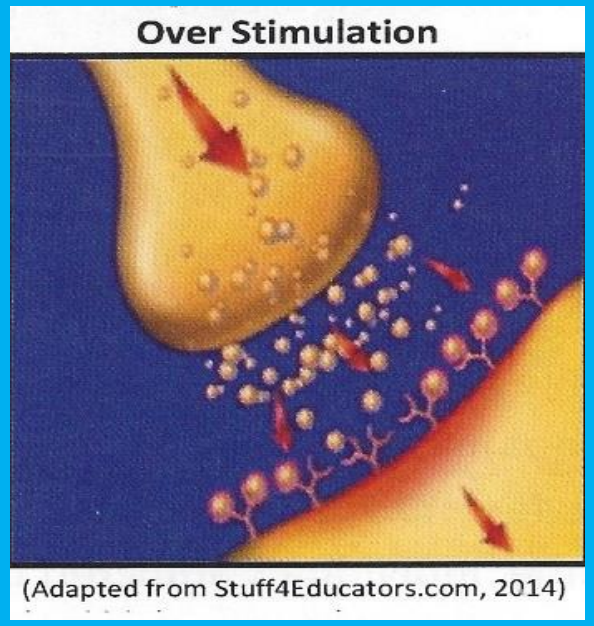
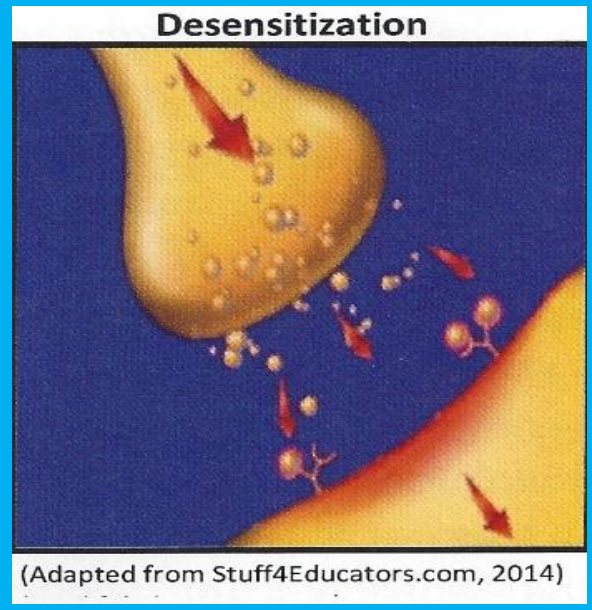
Dopamine and CREB – "Slow it Down, Silver!"

- As the brain recognizes that it needs a rest, it will kick out **CREB** in an effort to slow things down (Wilson, 2014).
- In essence, **DeltaFosB** acts like the gas pedal and **CREB** functions as the brakes.
- CREB specifically inhibits dopamine and endogenous opioids in an effort to take the joy out of the binging/addictive behavior or substance so that you can give it a rest.
- This numbed pleasure response that is induced by CREB is often identified as **desensitization** which leads to **tolerance** - the need of increasingly higher doses to achieve the same effect. Tolerance is a key factor in addiction.

DOPAMINERGIC DOWNREGULATION AT THE SYNAPTIC LEVEL







So, we see that chronic overstimulation can lead to two opposite effects:

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Increased dopamine activity (wanting/seeking it more) –

sensitization via **DeltaFosB**

02

Decreased dopamine and opioid activity (liking it/enjoying it less) – **desensitization** via **CREB**

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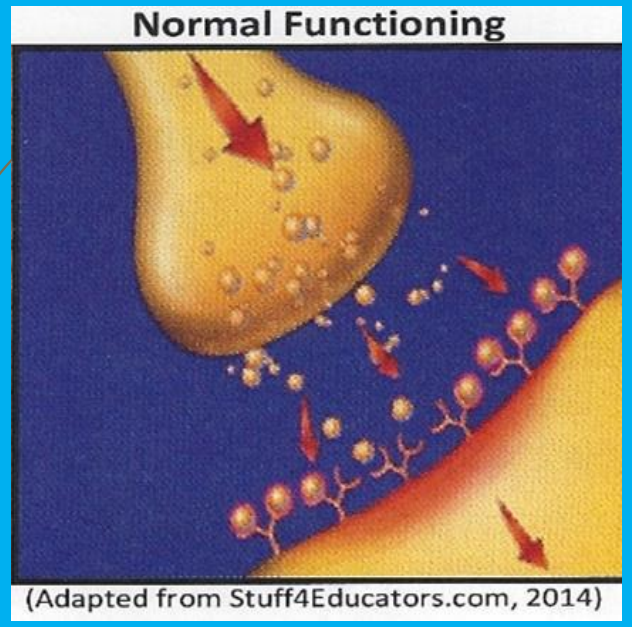

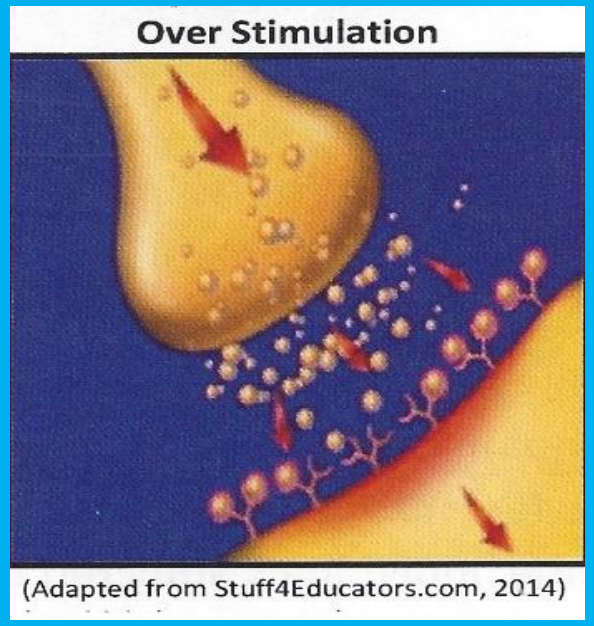

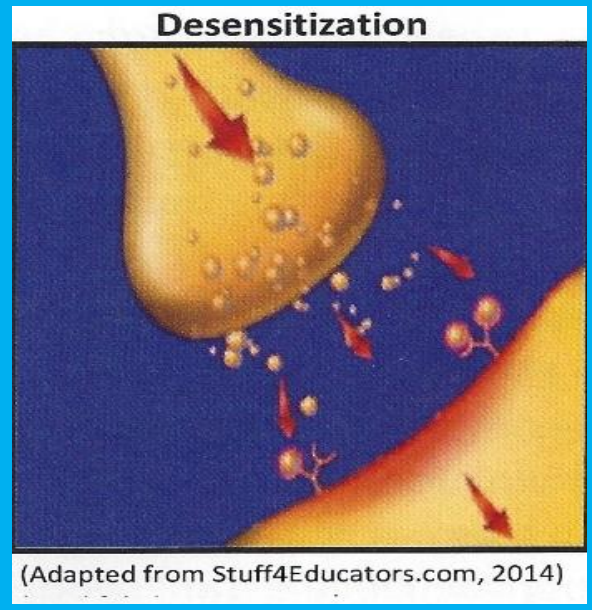

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Summary of dopamine increases:

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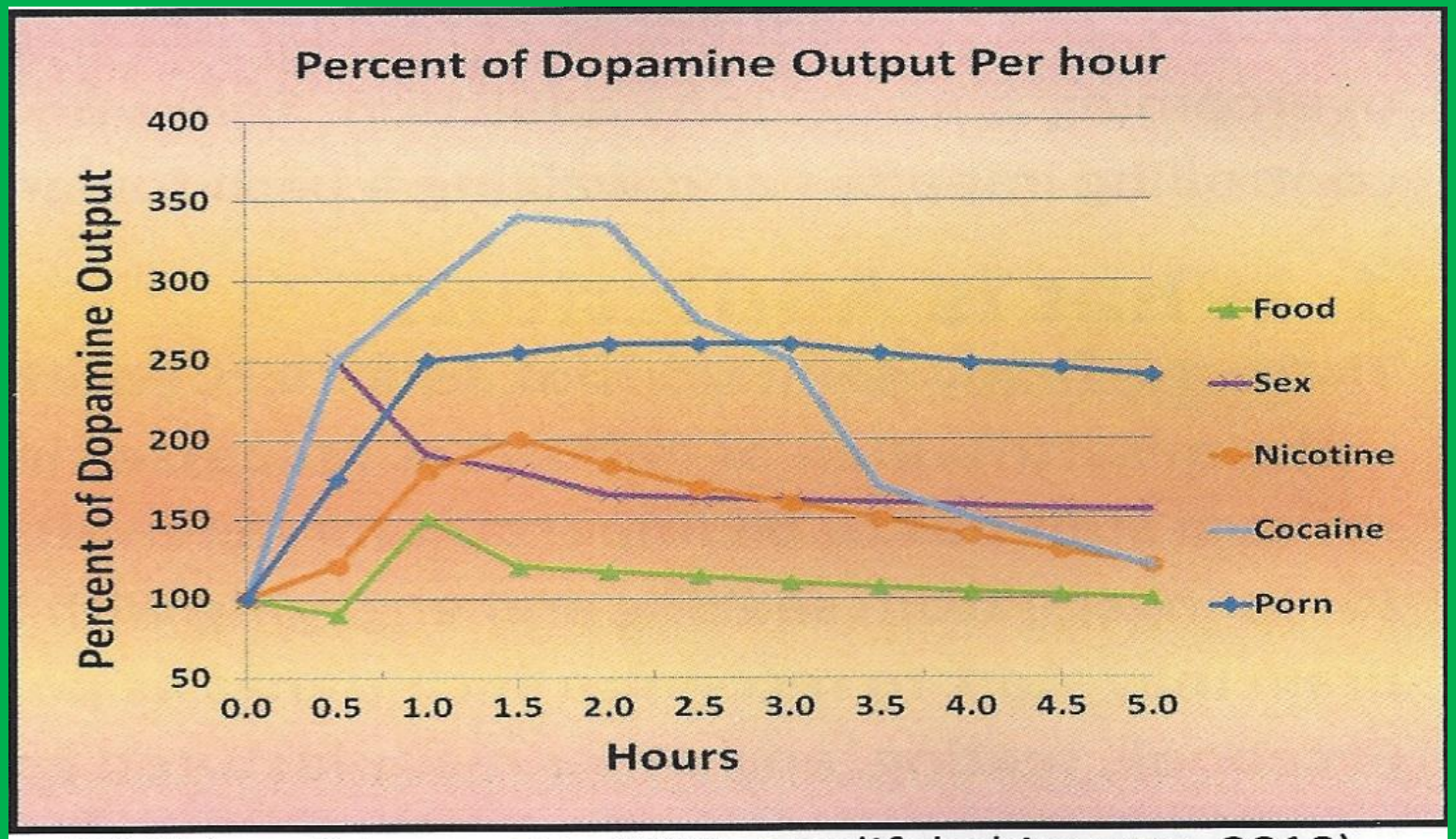
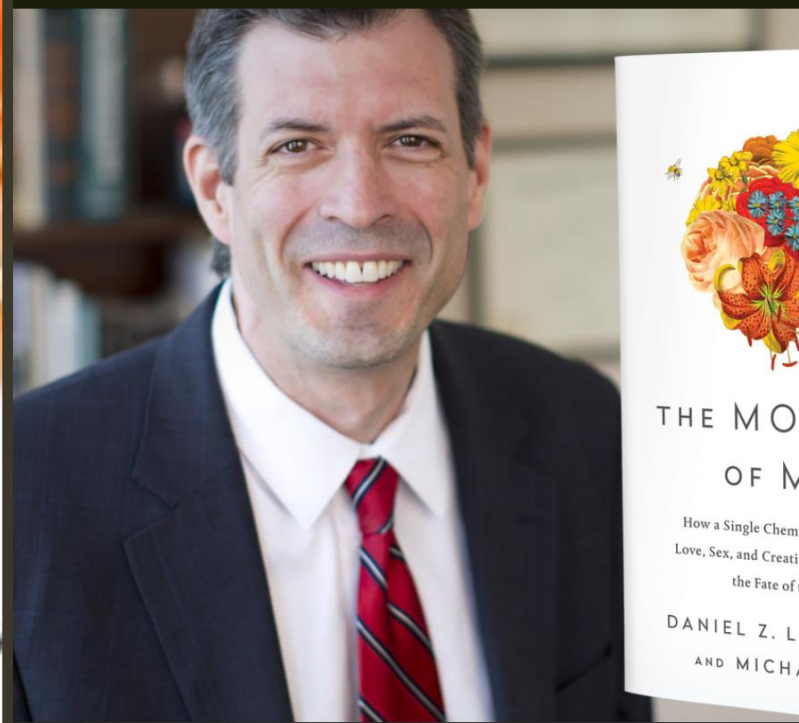
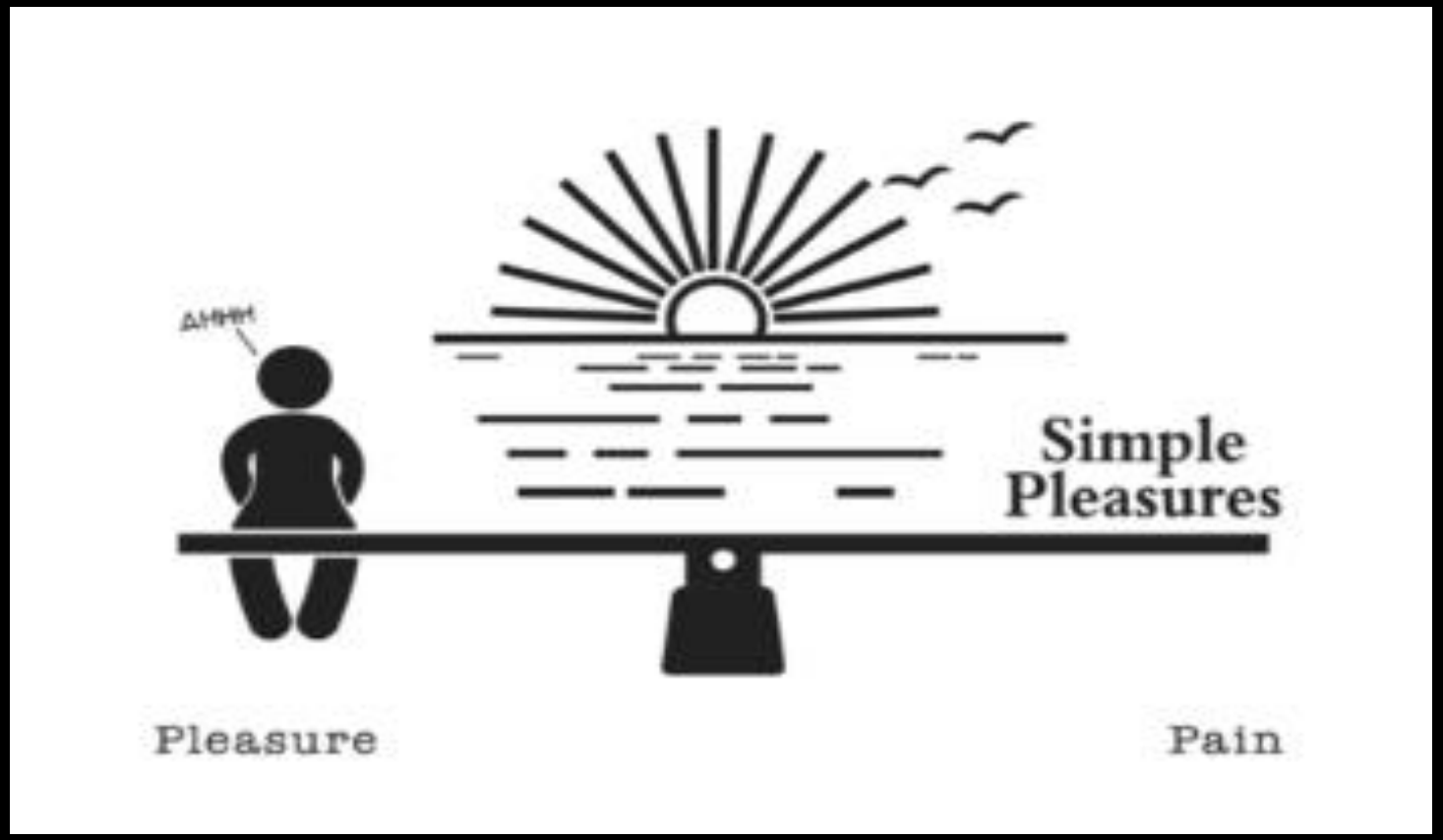


(Di Chiara & Imperato, 1988; newlifehabits.com, 2010)

The next few slides are from groundbreaking work of Dr. Anna Lembke and Dr. Daniel Lieberman and give us additional insights into how dopamine impacts the addiction process.



Pleasure and Pain Nicely in Balance



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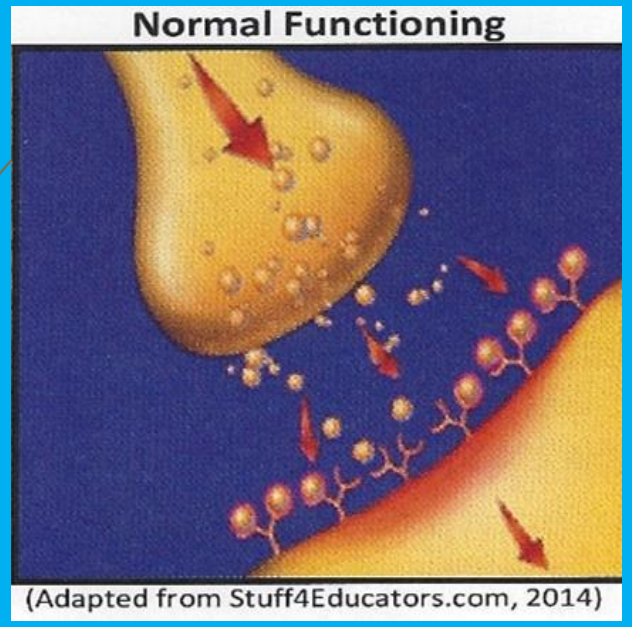

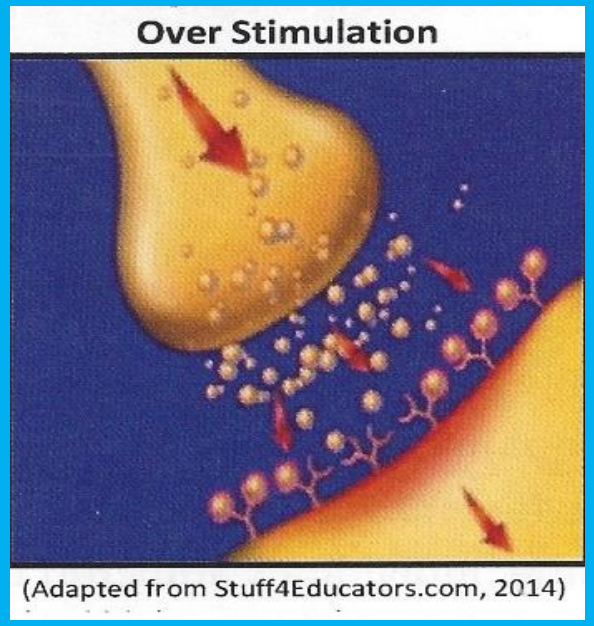

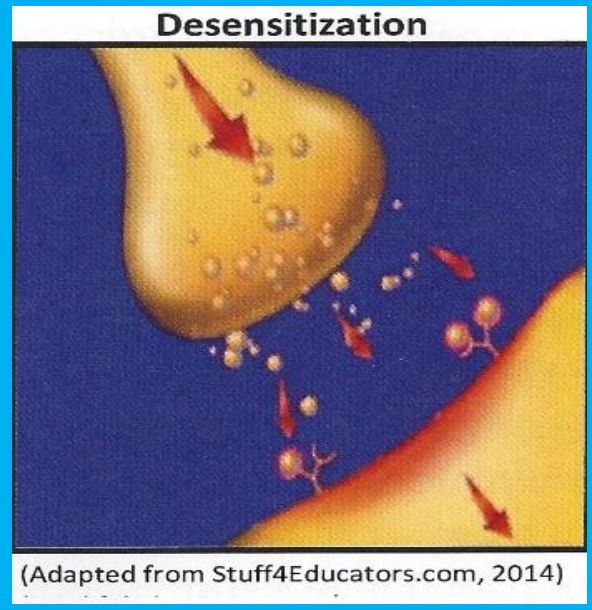

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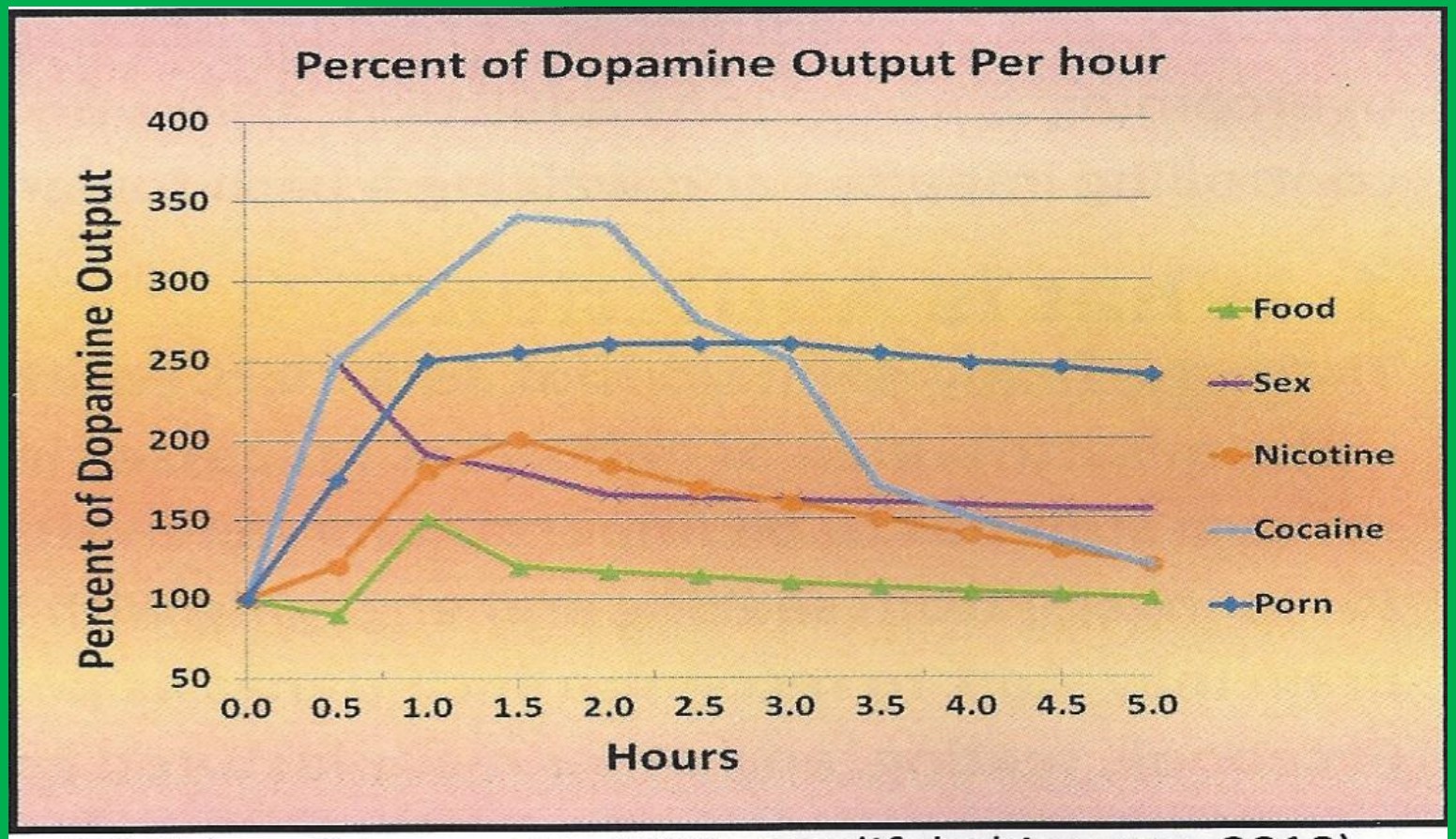

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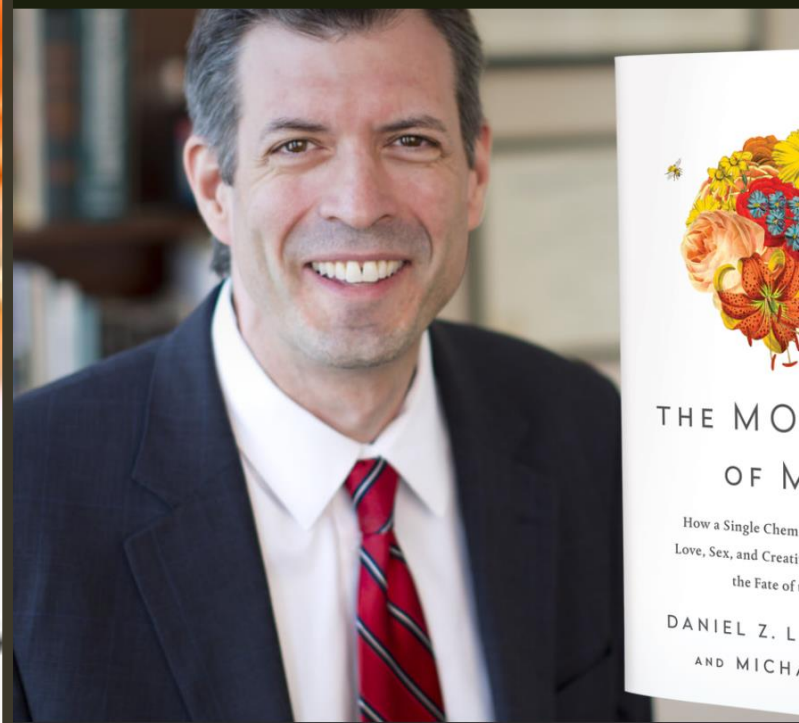

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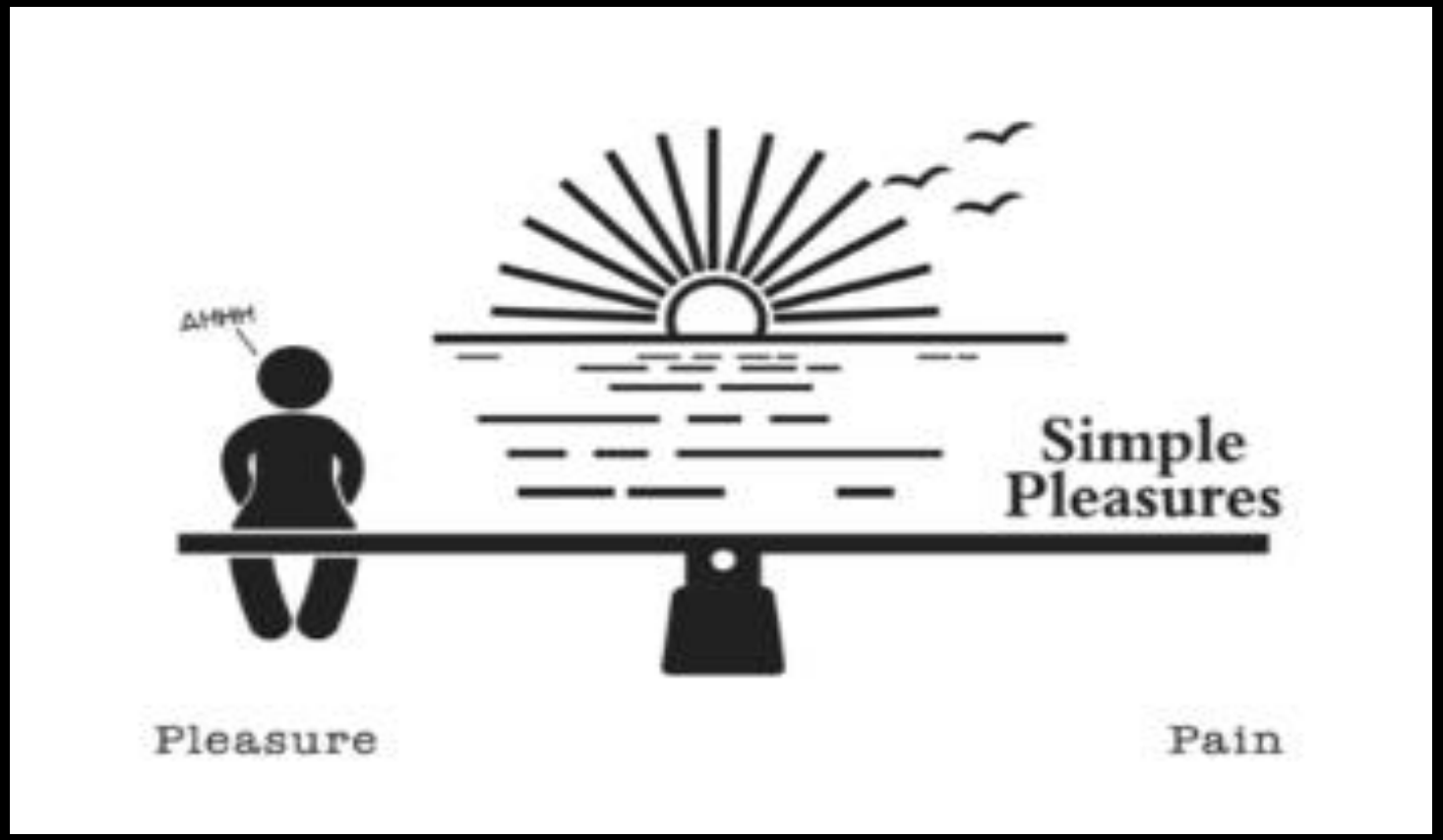

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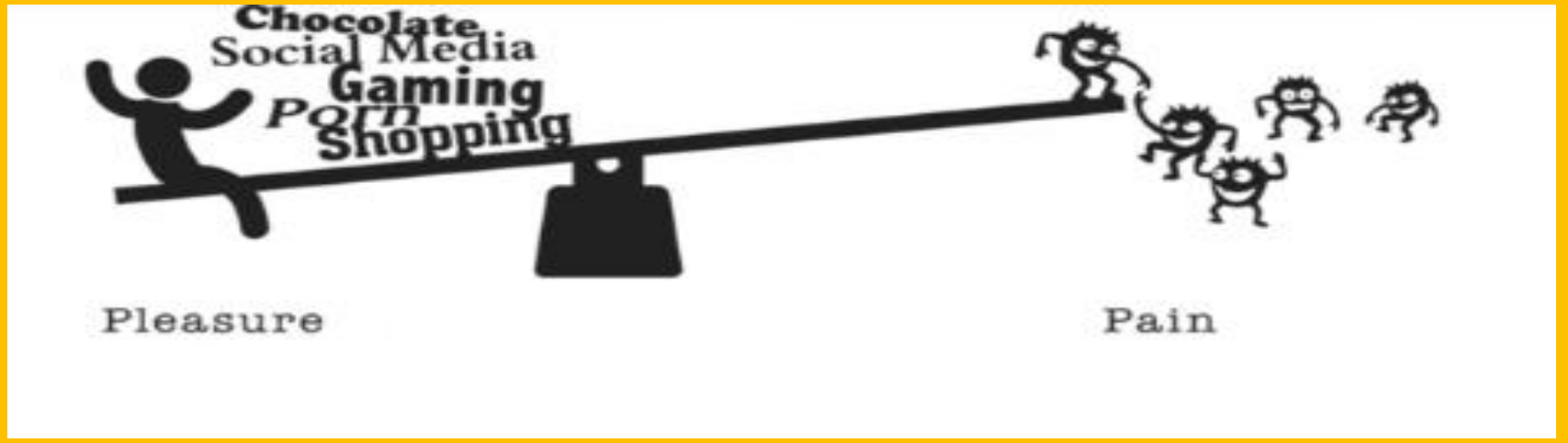

Our brain down-regulates our dopamine to bring us back to homeostasis (gremlins jumping on the lever).

As we actively seek pleasure, pain gremlins begin to jump on the teeter totter to try to restore homeostasis balance.

Anna Lembke (2021)
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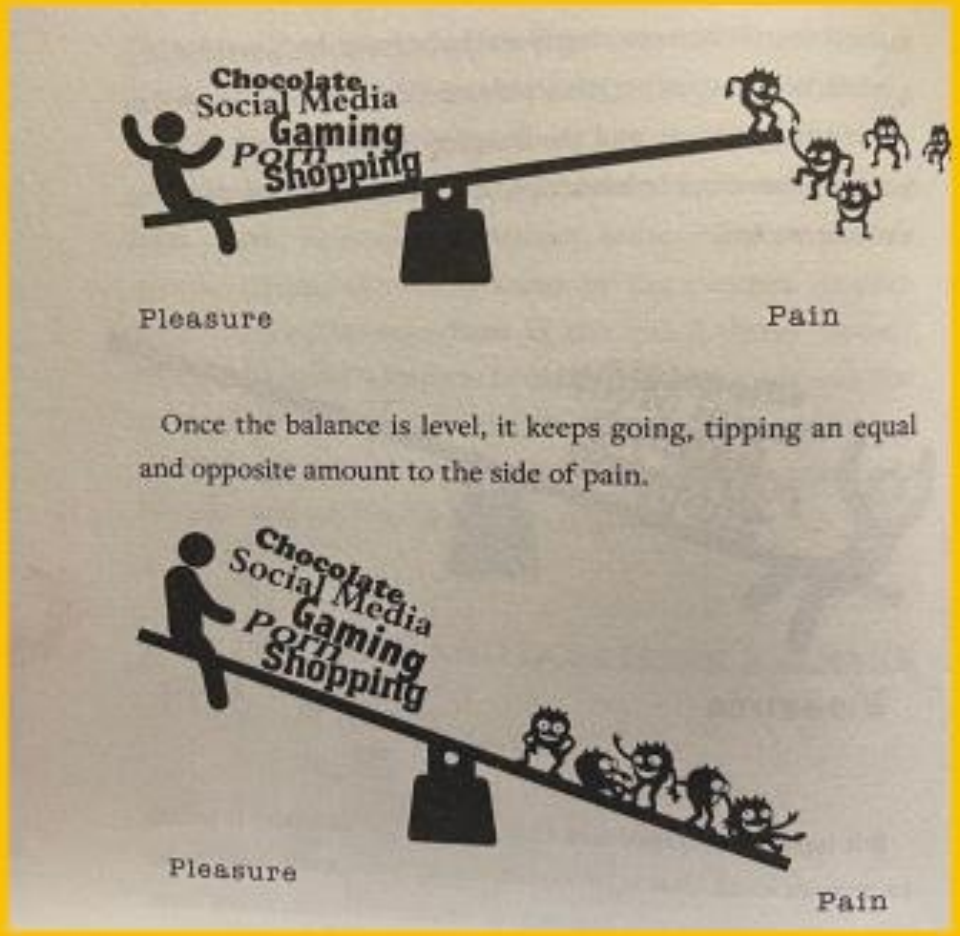
Pleasure – Pain Shift



Pain circuits activate in order to move toward homeostasis or balance

Then the balance is more on the "pain" side which is where we want more to feel "normal" again.

Anna Lembke, 2021, https://www.youtube.com/watch?v=5Pu82wZRZwo&ab_channel=AndreaSamadi

Pleasure and pain out of balance

This is a dopamine-deficit state, where we are walking around unhappy.

Dopamine Nation "It's harder for us to experience pleasure and more likely we will experience pain."

Anna Lembke (2021)
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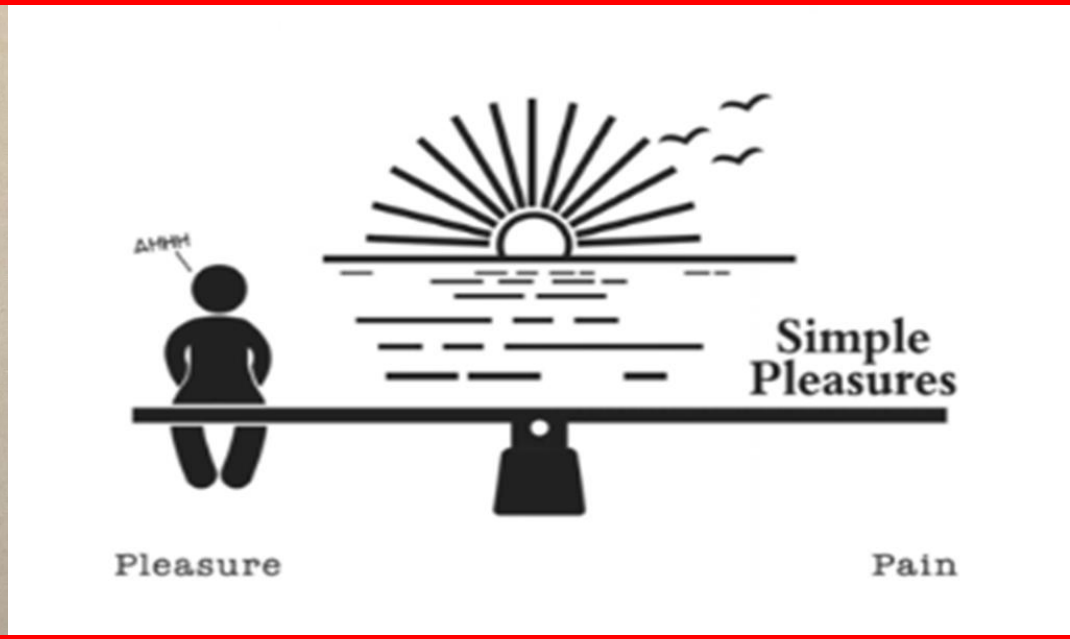
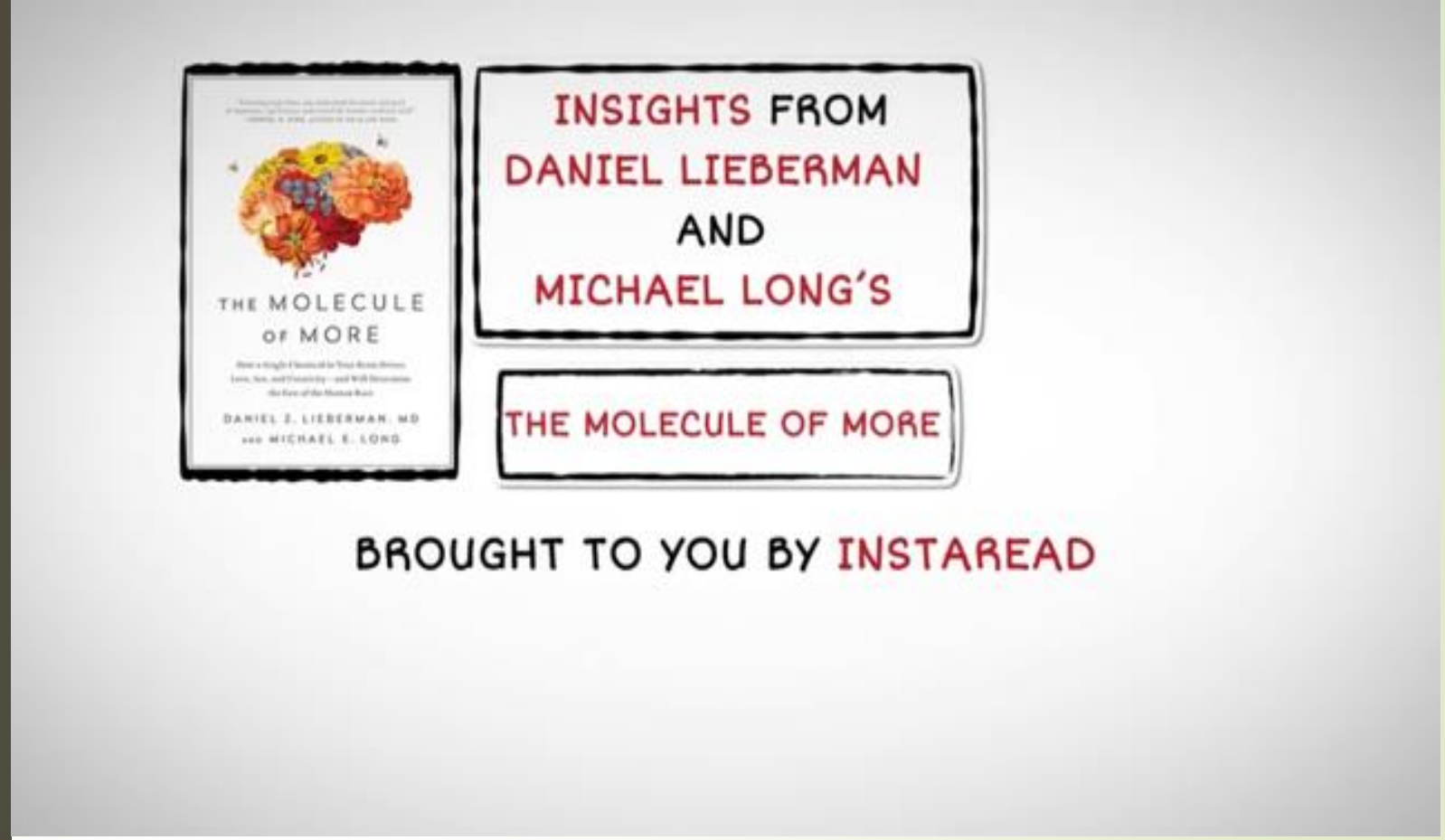
Dr. Lembke recommends a 30-day dopamine fast in order to rebalance the dopaminergic circuits in the brain.



Anna Lembke (2021)

The following slides are taken largely from Dr. Lieberman's excellent book, *The Molecule of More*



The Molecule of More

Click here to listen to Dr. Lieberman:
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Click here to listen to animated video on Molecule of More:
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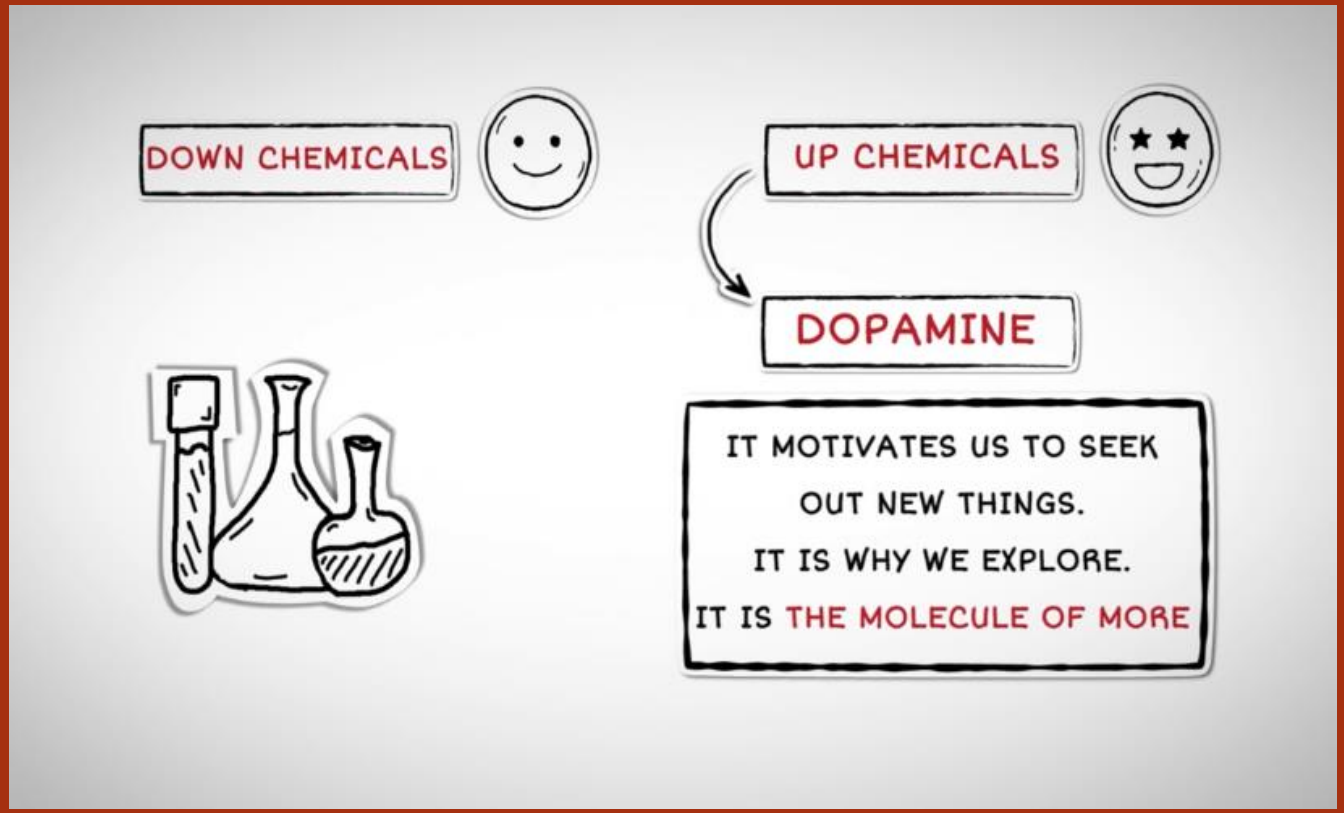
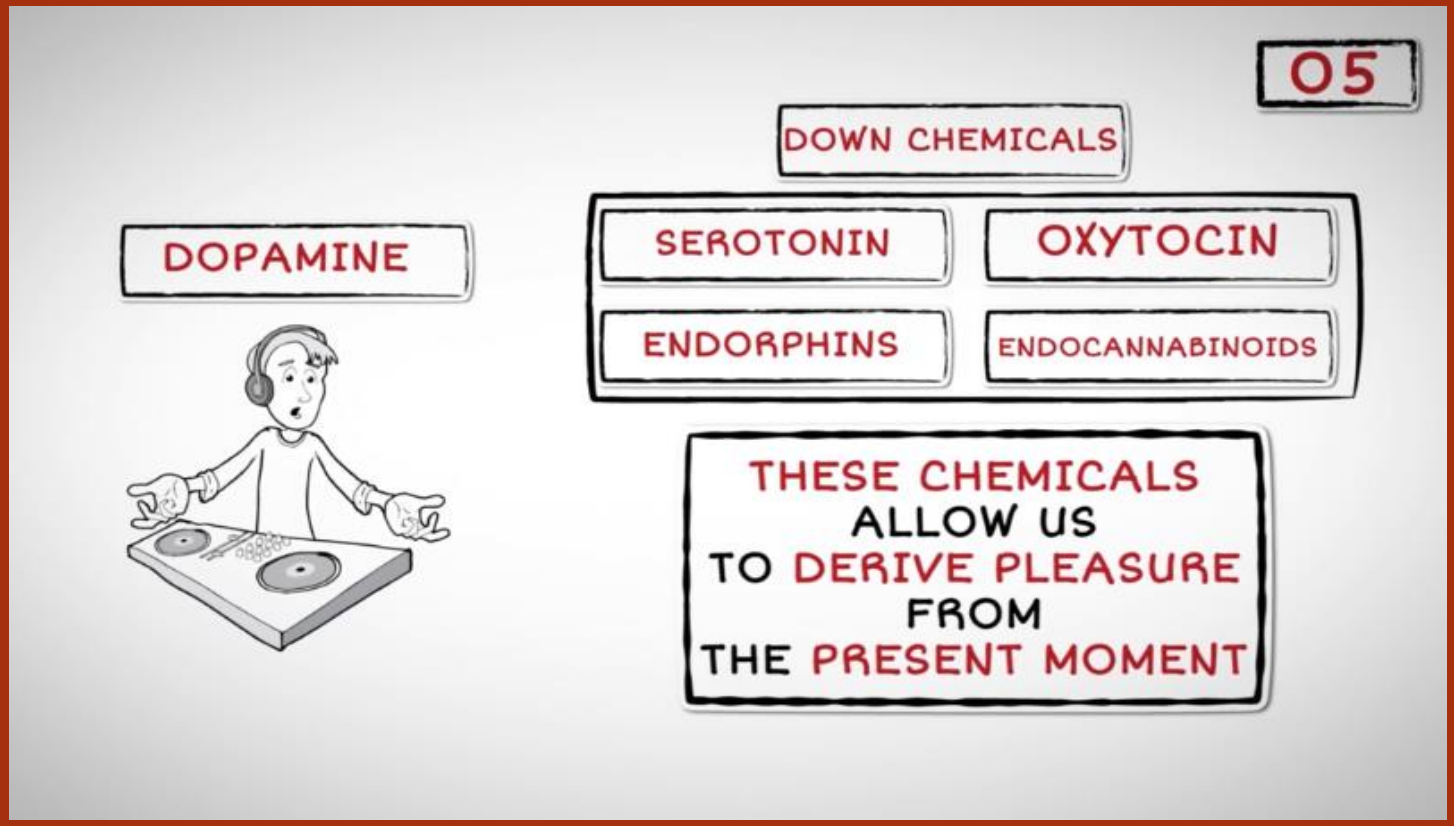
The brain has up chemicals and down chemicals

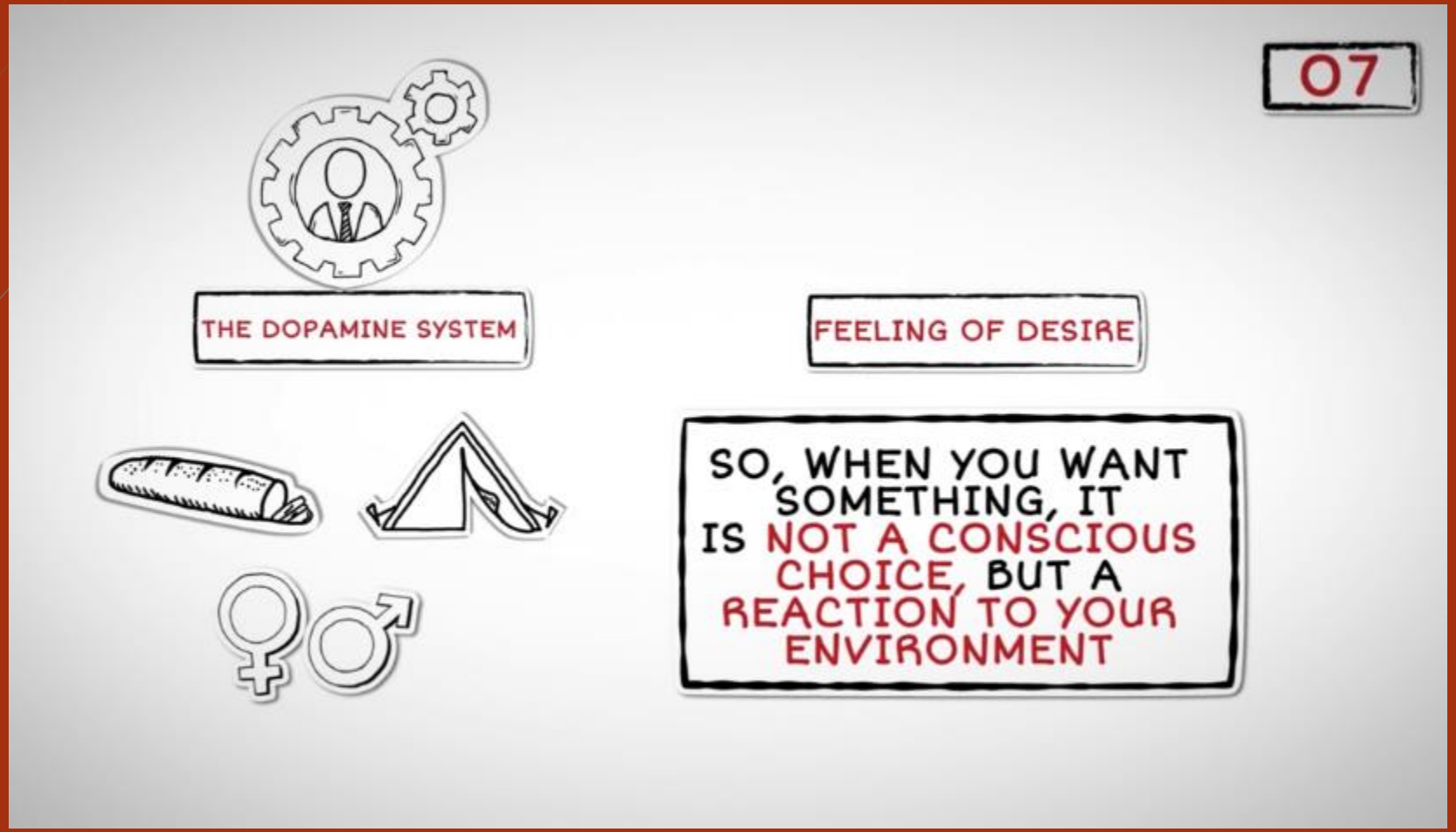
The up chemical dopamine drives us to seek new things



The Down Chemicals – designed for the here and now

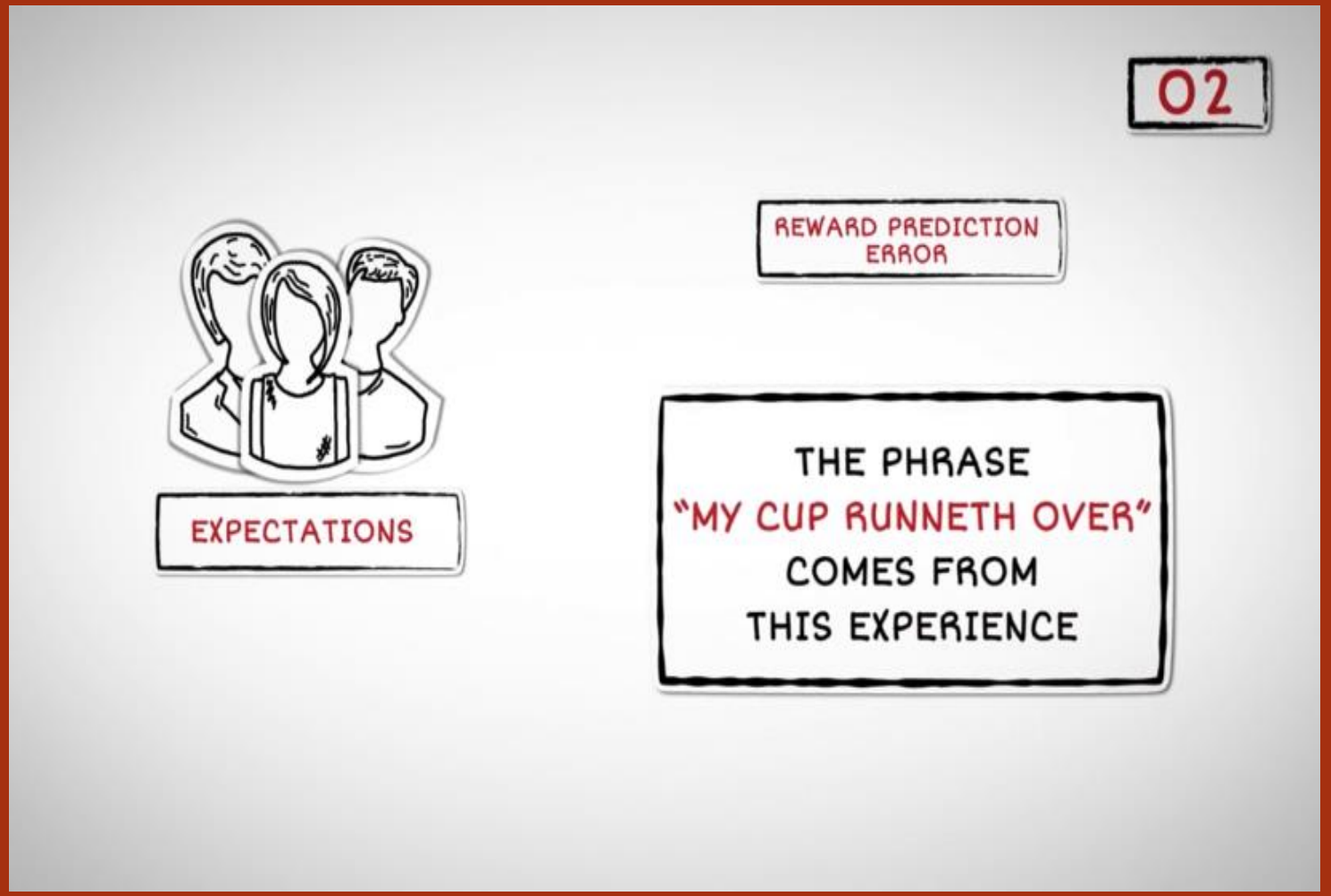


Dopamine is future-oriented and less conscious in process



Reward Prediction Error

When the expected becomes unexpected which increases dopamine dramatically and compels us to continue seeking the new thing. This can become addicting.



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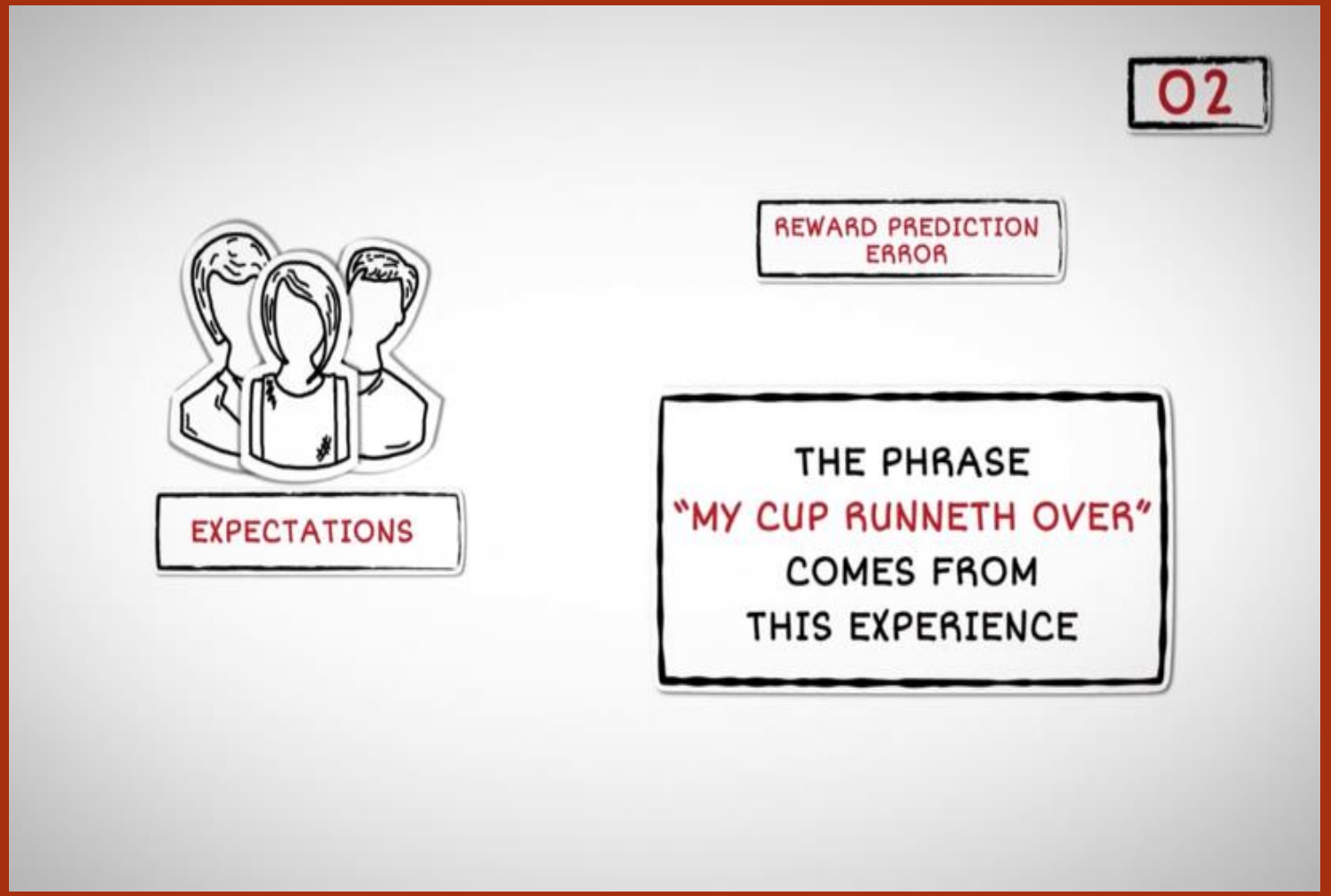
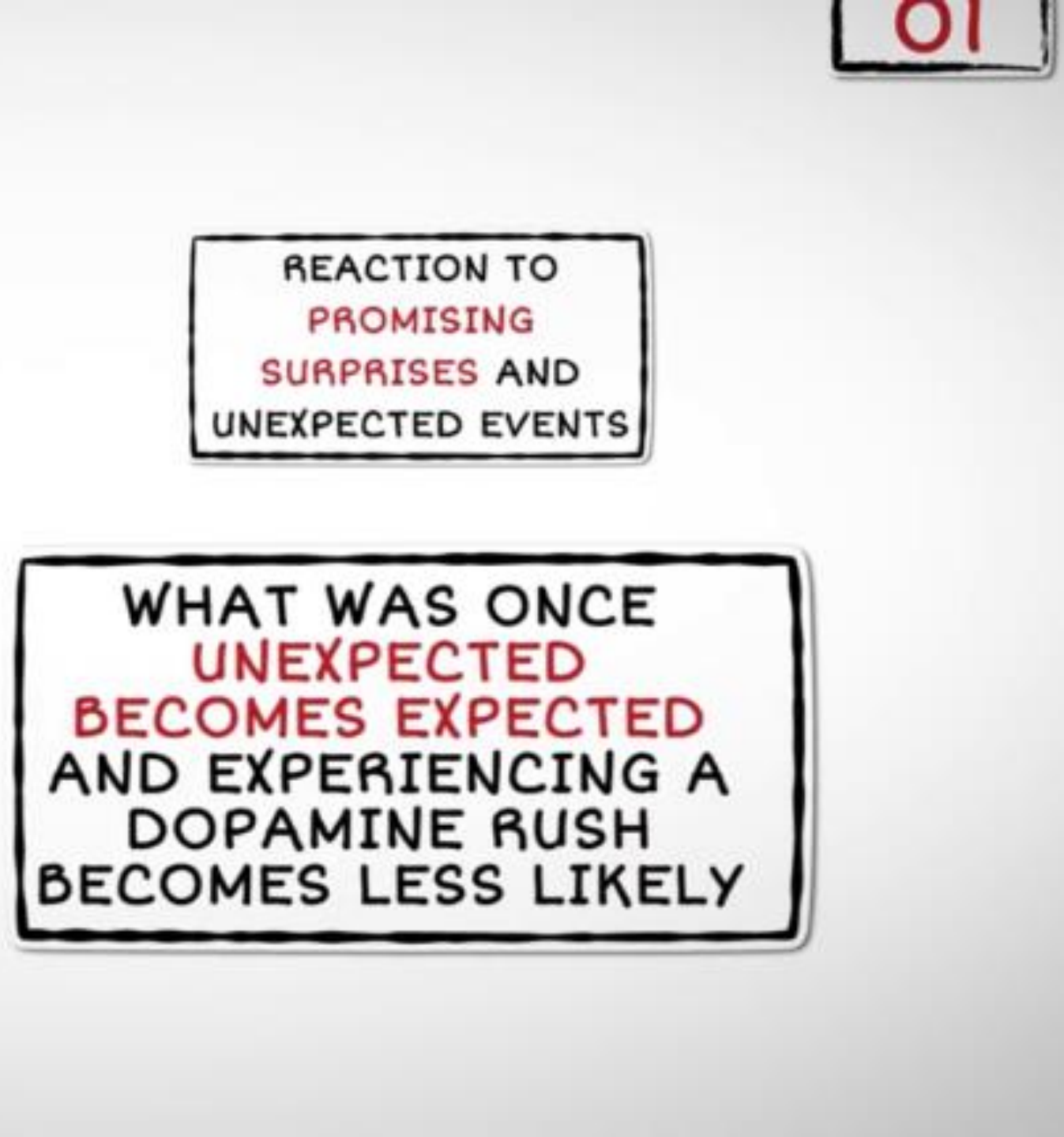
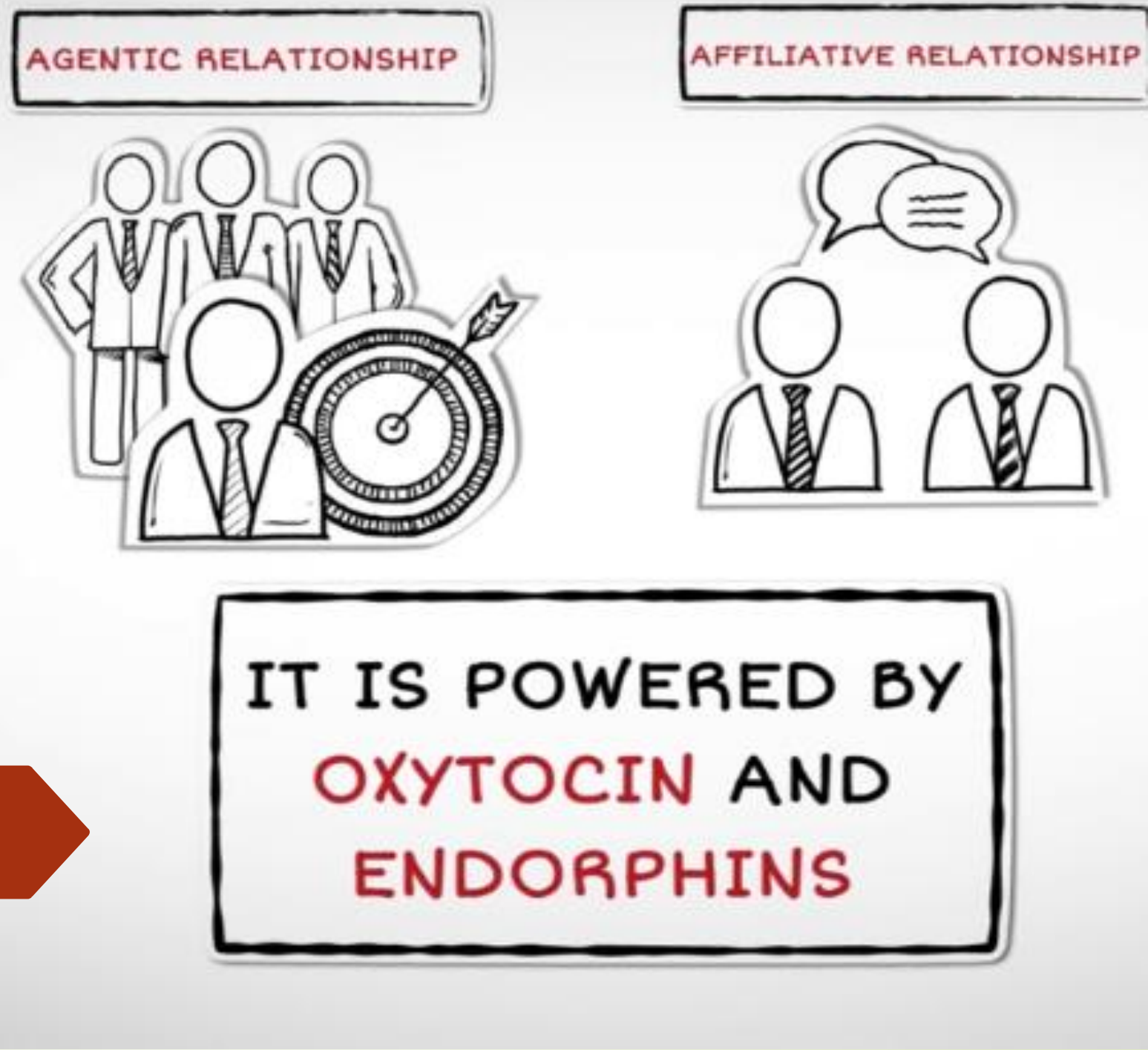


Dopamine drops when the unexpected becomes expected.

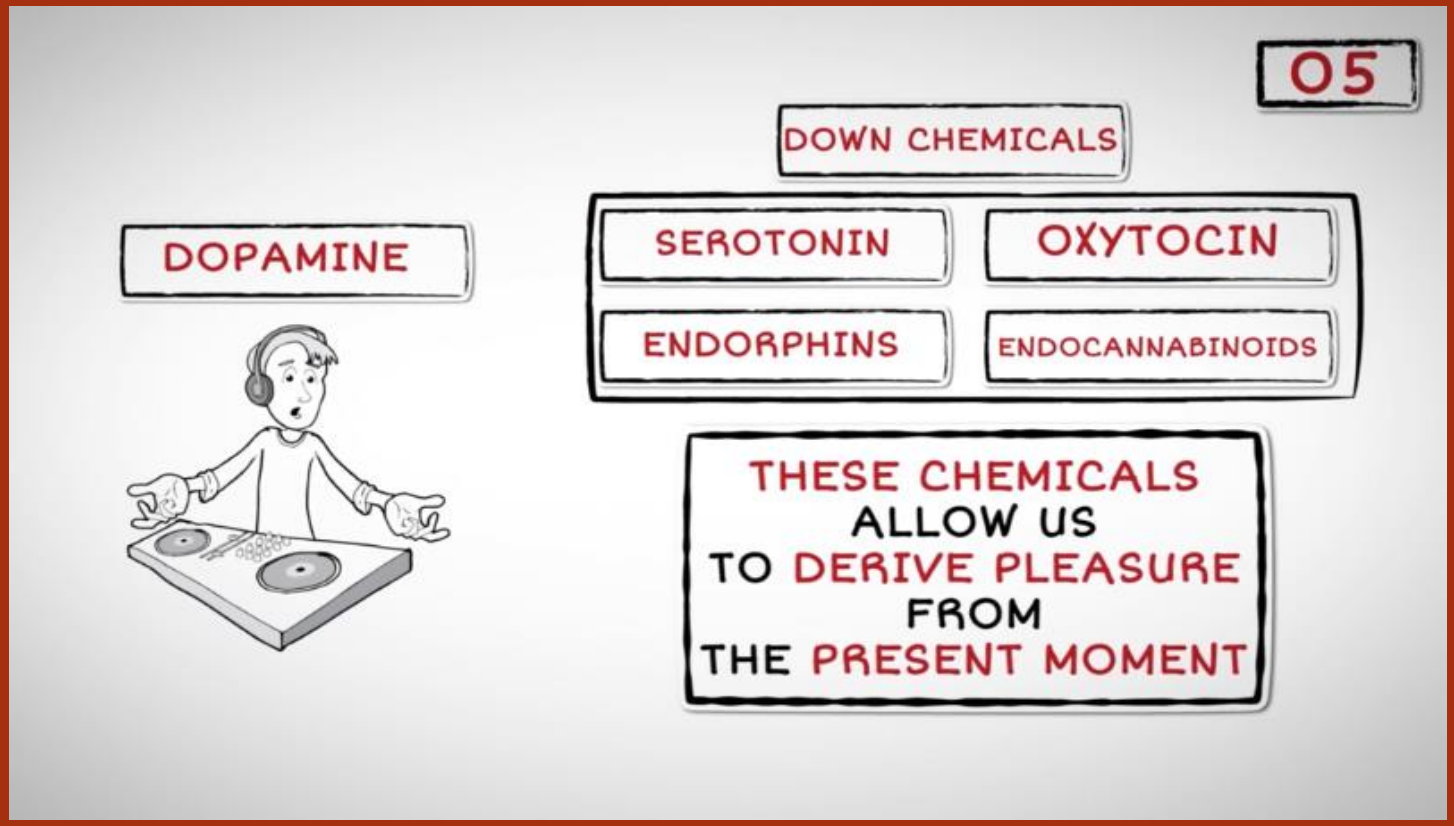


We can then possibly decide to end the cycle.

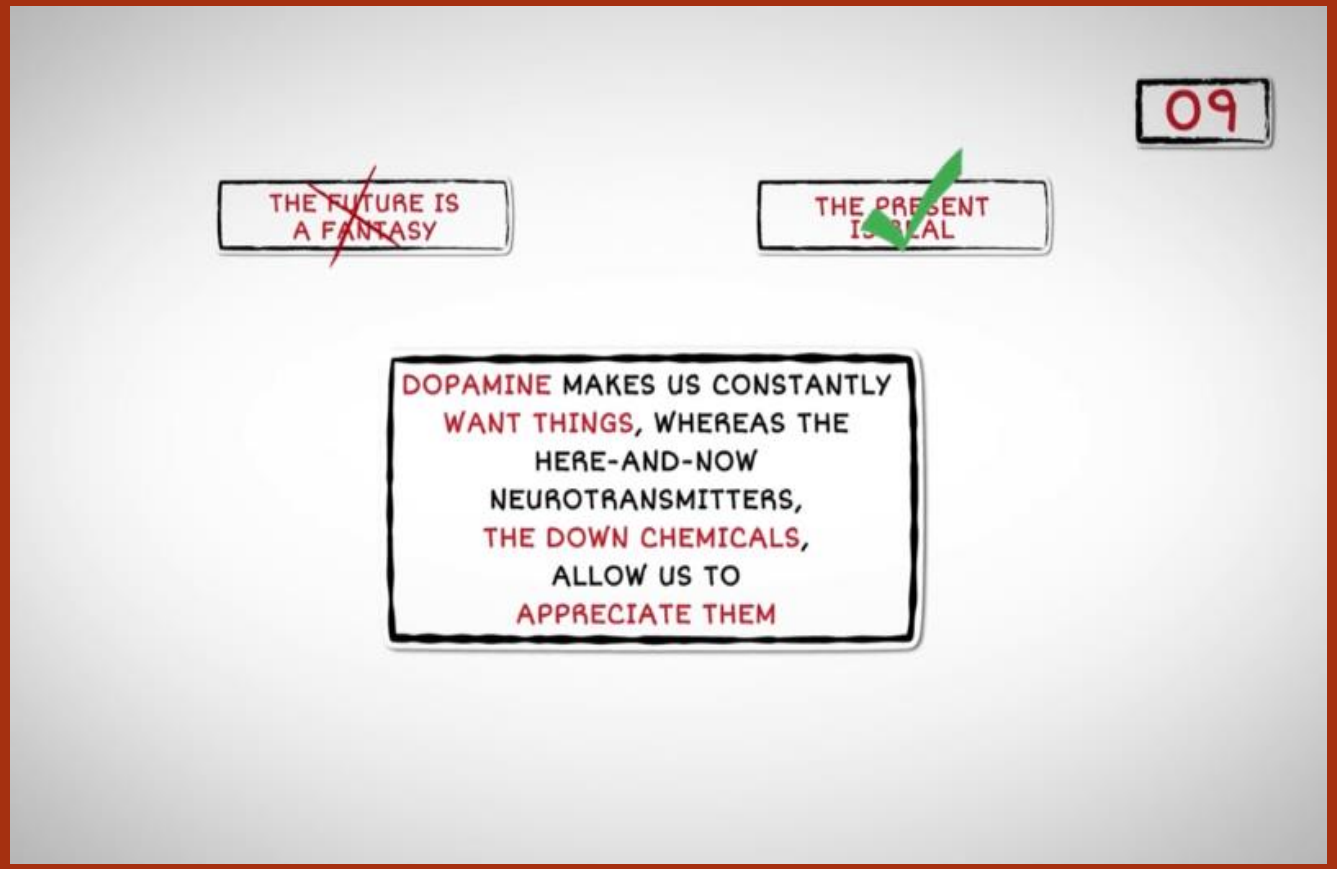
Here & Now Circuits allow us to back off the future pursuit and enjoy the present and all that it offers – relationships, peace, connection



If we end the dopamine rush, we are able to enter into the here and now zone driven by the down chemicals.



Being able to shift from future craving (dopamine) to the present (here and now chemicals) is essential to mental health



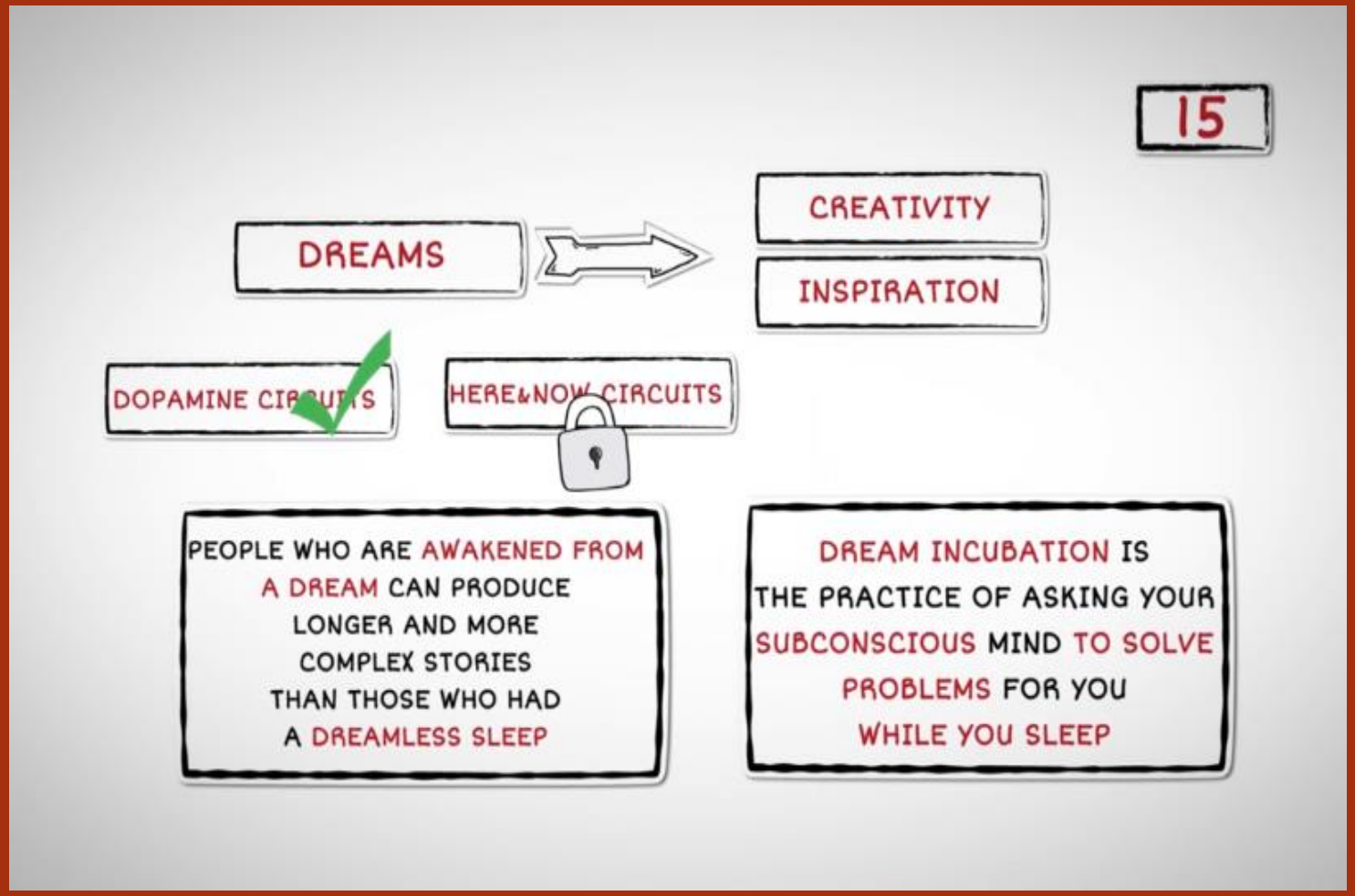
Dopamine fixes us on a future target and can be a good thing if balanced

Dopamine used well: Fix on the target and ignore the distractions

CHARLES DARWIN

ONLY THE STRONGEST AND MOST ADAPTABLE ORGANISMS SURVIVE LONG ENOUGH TO REPRODUCE. OFTEN, IT IS THOSE WITH HIGH DOPAMINE WHO FIND IT EASIEST TO ADAPT

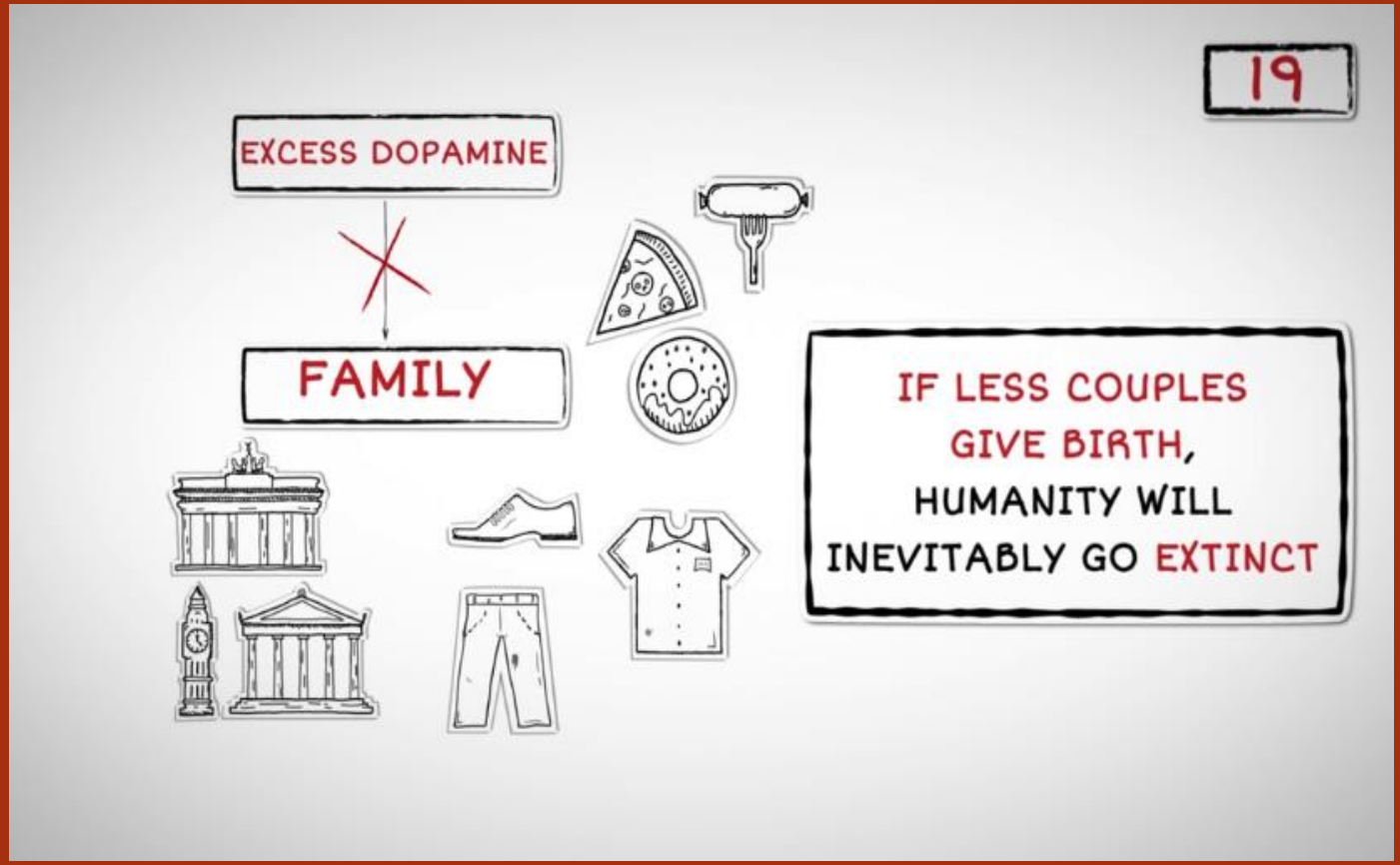
Dopamine used well: Creativity and Inspiration



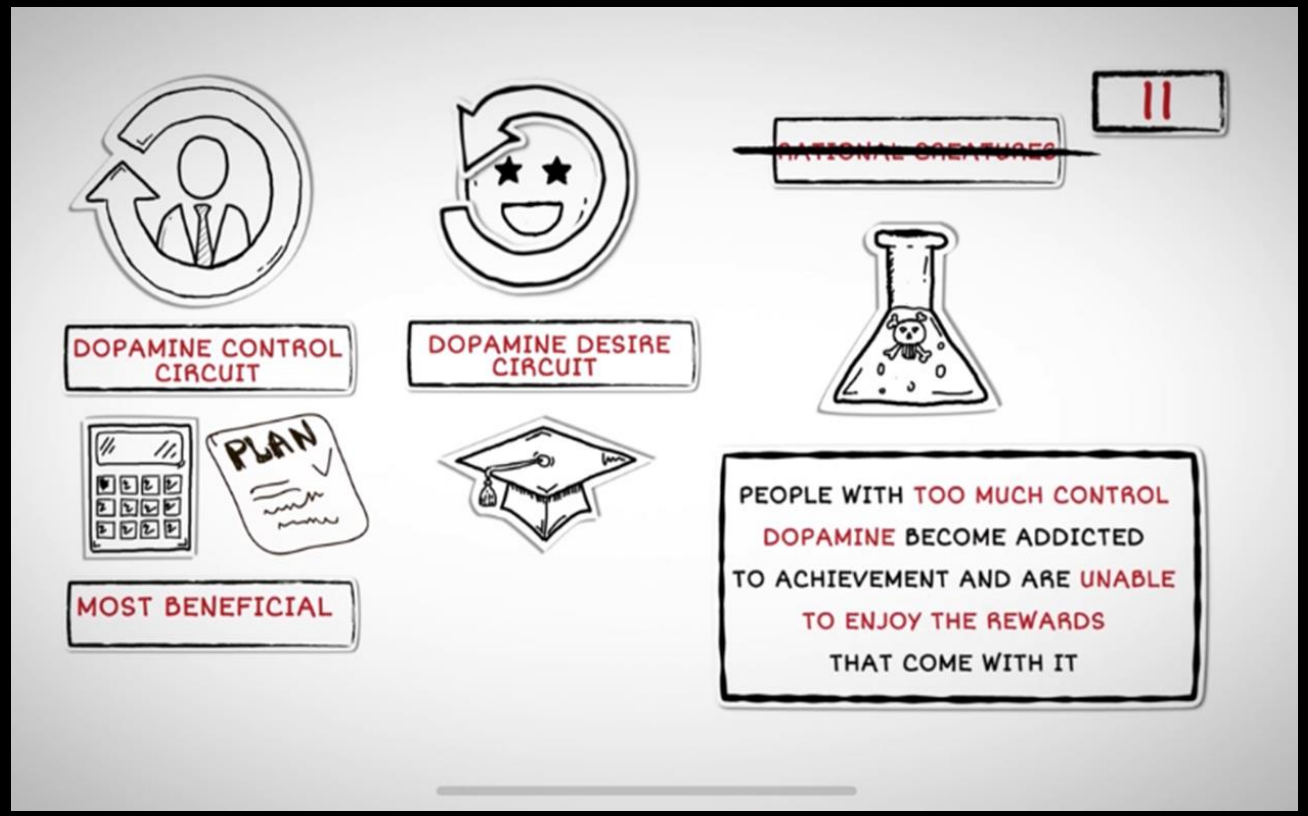
Dopamine when used poorly can lead to escalation and then ultimately addiction

Too much dopamine and too little Here & Now Chemicals are anti-family/procreation.

You get the goal but arrive there alone!



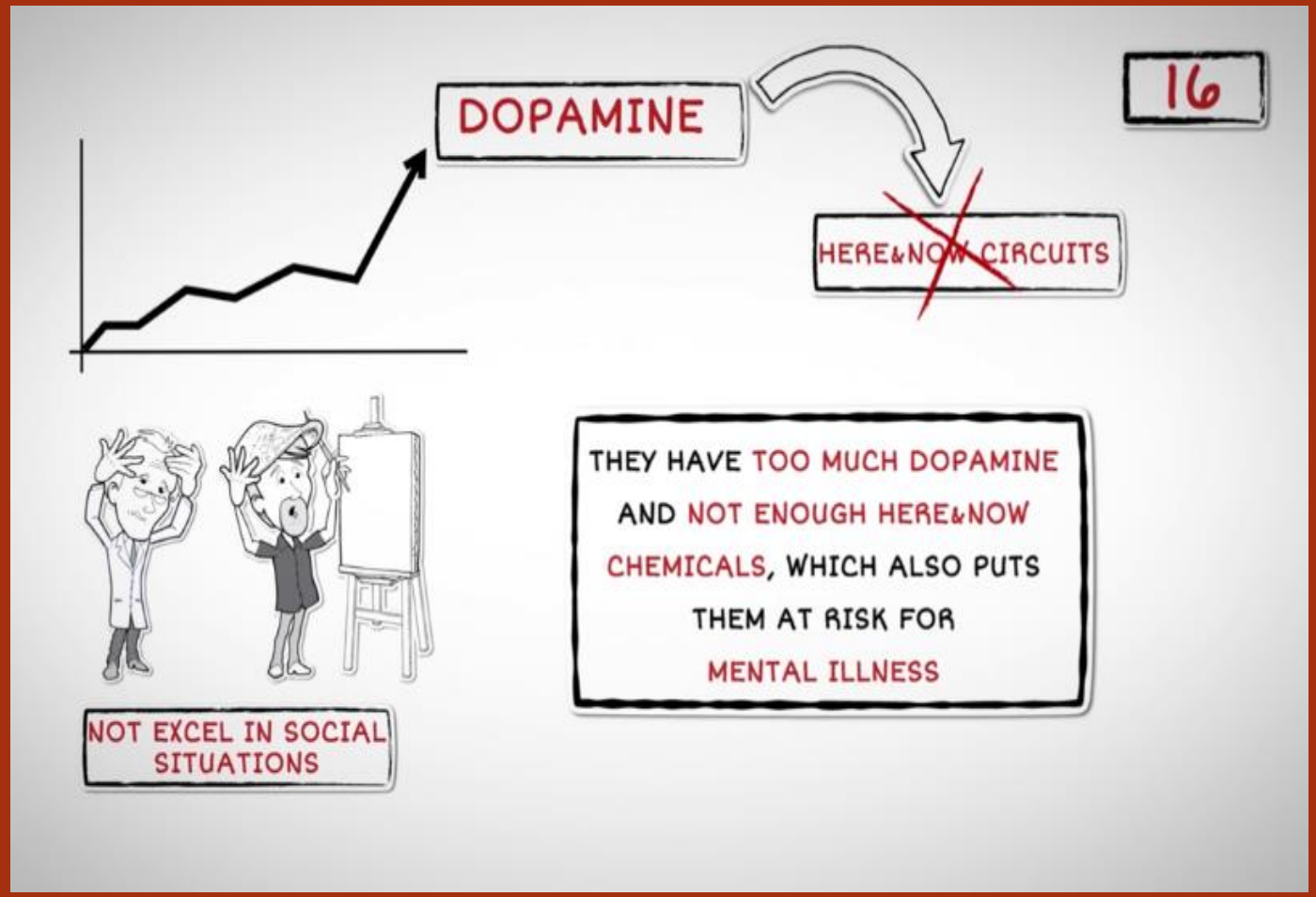
Dopaminergic Desire and Control Circuits



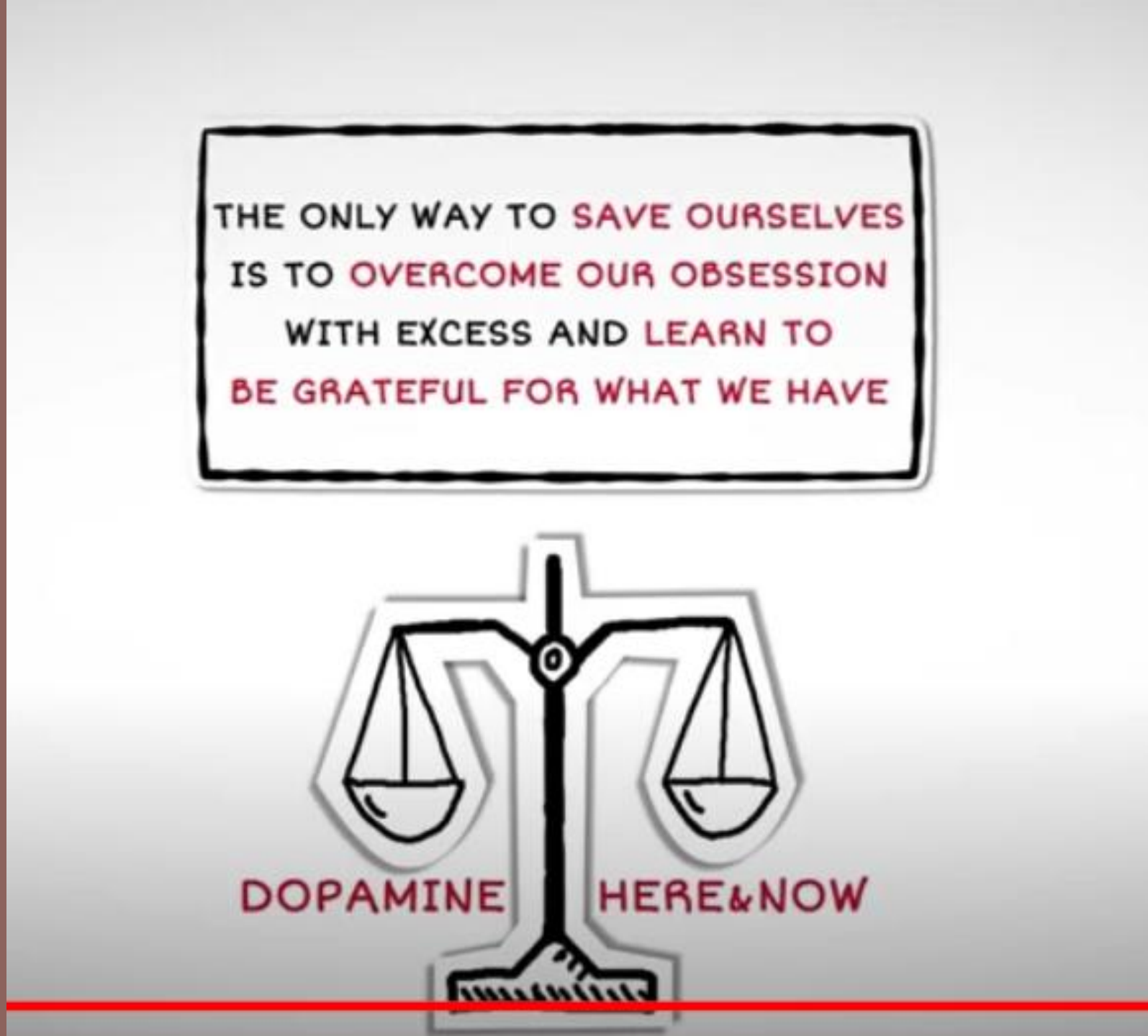
There are two main dopaminergic circuits:

- The dopamine desire circuit (meso-limbic circuit) moves us toward more immediate future targets .
- The dopamine control circuit (meso-cortical-limbic) allows us to use the prefrontal cortex to apply the brakes if needed and evaluate the cost-benefit of moving toward the desired reward.

Excess Dopaminergic Circuits and too little Here & Now Circuits cause problems for us emotionally



When dopamine and here and now chemicals are in balance, our lives will be balanced, and we can enjoy peace



In conclusion

So, let’s choose to balance this amazing dopamine resource so we can live long and prosper.