Wireless Communication in the Brain: IV. Seek Pleasure, Avoid Pain

Frank Lee
eMail: frank@geon.us
Website: https://www.geon.us

Posted on: October 28, 2020

Abstract

The "pleasure principle" of Sigmund Freud is the instinctive seeking of pleasure and avoiding of pain to satisfy biological and psychological needs. This paper will explore the near omnipotent behavior from neuroscience and physics perspective. Within the framework of Geon Hypothesis, pain arises from high density of gravitational (GR) and electromagnetic (EM) waves in the geon, while pleasure is linked to decreased wave density. Therefore, if the external stimulus reduces the wave density, it should promote the pursuit of this stimulus. Conversely, the painful stimulus should increase wave density, resulting in avoidance. On the other hand, neuroscience has established that the action selection is governed by three different pathways from the motor cortex to the thalamus: direct, indirect and hyperdirect. In the striatum, an increase in dopamine (DA) or a decrease in acetylcholine (ACh) stimulates the direct pathway, while DA reduction or ACh increase stimulates the indirect pathway. These well-documented neuroscientific findings, together with the Geon Hypothesis, can account for the pleasure principle.

Introduction

According to Geon Hypothesis, the mind is a Bose–Einstein condensate (BEC) of gravitational (GR) and electromagnetic (EM) waves, also known as a "geon". The GR waves cannot influence neural activity due to their extremely weak interaction with matter, but they play a critical role in the formation of BEC which can increase the coherence time of information stored in the mind geon (Paper 12). The EM waves of the geon have the capacity to influence neural activity by interacting with microtubules. Paper 1 has shown how this property may mediate long-range neuronal synchronization. Paper 12 further shows that working memory could be located in the mind geon where the EM waves could be manipulated for cognitive tasks.

"Seek pleasure, avoid pain" is an instinctive behavior that was traditionally in the realm of psychology. Now that we have identified what the mind is, this paper will explore the behavior from neuroscience and physics perspective. Within the framework of Geon Hypothesis, pain arises from high density of GR and EM waves in the geon (Chapter 7), while pleasure is linked to decreased wave density (Chapter 8). Therefore, if the external stimulus reduces the wave density, it will promote the pursuit of this stimulus. For example, the sighting of a pretty woman will cause someone to take another look. After listening to a beautiful song, you may want to listen again. A delicious food will attract you to eat it one more time. Conversely, if the external stimulus makes you feel painful, you would want to avoid it. How does the nervous system turn feeling into action?

"Go" or "No-Go"

Life experiences were accumulated from countless actions. Before taking any action, there are only two choices: "Go" or "No-Go". For instance, a boy who meets an unfamiliar pretty girl would like to move forward to chat with her. The boy will face two choices: "Go" or "No-Go". It has been well established that the **striatum** plays a crucial role in action selection.

The action of the body is caused by muscle contraction which, in turn, is controlled by motor neurons. The center for behavioral decision-making is located in the motor cortex. Efferent signals from the motor cortex to motor neurons must pass through a thalamic area responsible for motion. As long as the motor-related neurons in the thalamus fire, action will be triggered. Signals from the motor cortex to the thalamus can be divided into three pathways: direct, indirect and hyperdirect (Figure 1).

The direct pathway promotes neuronal firing in the thalamus, which tends to induce the "Go" selection. Indirect and hyperdirect pathways inhibit neuronal firing in the thalamus, thereby facilitating "No-Go" (Figure 1). Hesitation occurs when the two forces are roughly equal. Note that the direct and indirect pathways are bifurcated at the striatum, whereas the hyperdirect pathway does not go through the striatum.

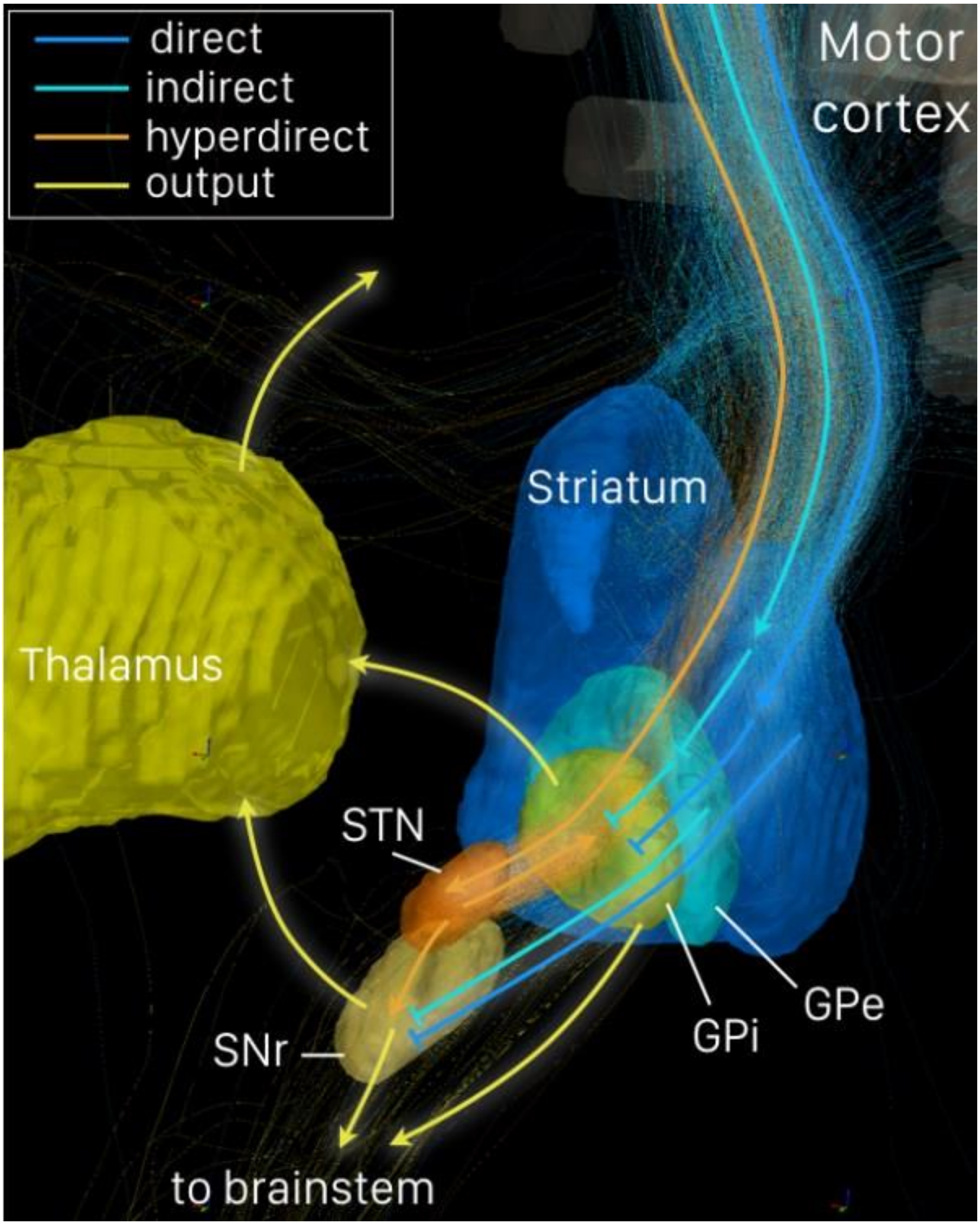

Figure 1. Action pathways. Signals from the motor cortex to the thalamus can be divided into three pathways.

Direct pathway: Motor cortex → Striatum ⊣ GPi/SNr ⊣ Thalamus.
Indirect pathway: Motor cortex → Striatum ⊣ GPe ⊣ STN → GPi/SNr ⊣ Thalamus.
Hyperdirect pathway: Motor cortex → STN → GPi/SNr ⊣ Thalamus.
Abbreviations: GPe: globus pallidus external; GPi: globus pallidus internal; STN: subthalamic nucleus; SNc: substantia nigra pars compacta; SNr: substantia nigra pars reticulata; → : excitatory; ⊣ : inhibitory.
[Image source: Wikipedia]

Action Selection at the Striatum

During information processing, the signal of feeling received by the brain will split at the striatum: pleasure and pain should go to direct and indirect pathways, respectively. What determines whether the signal of feeling should initiate the direct or indirect pathway? It has been known for decades that dopamine (DA) plays a critical role. If the concentration of DA in the striatum increases, it promotes the direct pathway, triggering the desire for the stimulus. Experiments have demonstrated that almost all addictive substances (opium, tobacco, alcohol, amphetamine, cocaine, etc.) increase the concentration of DA in the nucleus accumbens (NAc, a subdivision of the striatum). More recent studies found that acetylcholine (ACh) is also important for the action selection at striatum. However, the effect of ACh is just the opposite of DA: an increase in the concentration of ACh promotes the indirect pathway, leading to avoidance of the stimulus (more info).

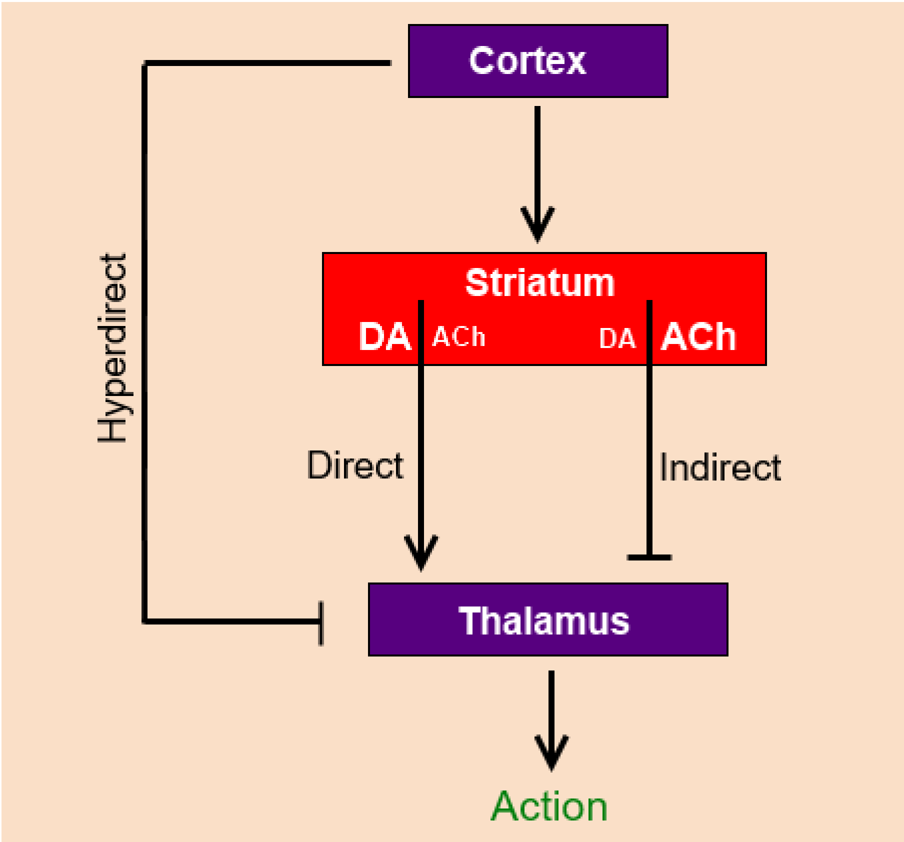

Figure 2. Action selection. For simplicity, GPe, GPi, STN and SNr in the three pathways from the motor cortex to the thalamus are omitted. Action will be triggered as long as the motor-related neurons in the thalamus fire. The direct pathway promotes action, while indirect and hyperdirect pathways have inhibitory effects on action. In the striatum, an increase in dopamine (DA) or a decrease in acetylcholine (ACh) stimulates the direct pathway. Conversely, DA reduction or ACh increase stimulates the indirect pathway.

Both DA and ACh are major neurotransmitters, produced by specific neurons. The neurons producing DA are called dopaminergic neurons or simply DA neurons. DA is released from the nerve terminal to the extracellular space when DA neurons fire. The neurons producing ACh are called cholinergic neurons or simply ACh neurons. They release ACh upon activation. The DA neurons of ventral tegmental area (VTA) provides major source of DA in the striatum. The main source of ACh comes from the short ACh neurons within the striatum. These ACh neurons do not project to other areas. When they fire, they increase ACh concentration in the striatum. To explain the behavior, "seek pleasure, avoid pain", the striatal DA should increase and ACh should decrease when one has pleasurable feeling. By contrast, the feeling of pain should be associated with decreased DA and increased ACh in the striatum. This notion is supported by the neural circuits of the brain.

Turn "Liking" into "GO" action

According to Geon Hypothesis, the feeling of pleasure results from the decrease in the density of GR and EM waves in the geon. EM waves can affect neuronal firing through microtubules: increased wave density promotes neuronal firing, while decreased wave density reduces the probability of neuronal firing (Paper 1). The geon covers the entire body and thus its EM waves may influence neuronal firing throughout the brain. For simplicity, Figure 3 shows only three brain regions: prefrontal cortex (PFC), thalamus and sensorimotor cortex (SMC). PFC regulates the concentration of DA in the striatum; the thalamus and SMC regulate the concentration of ACh in the striatum.

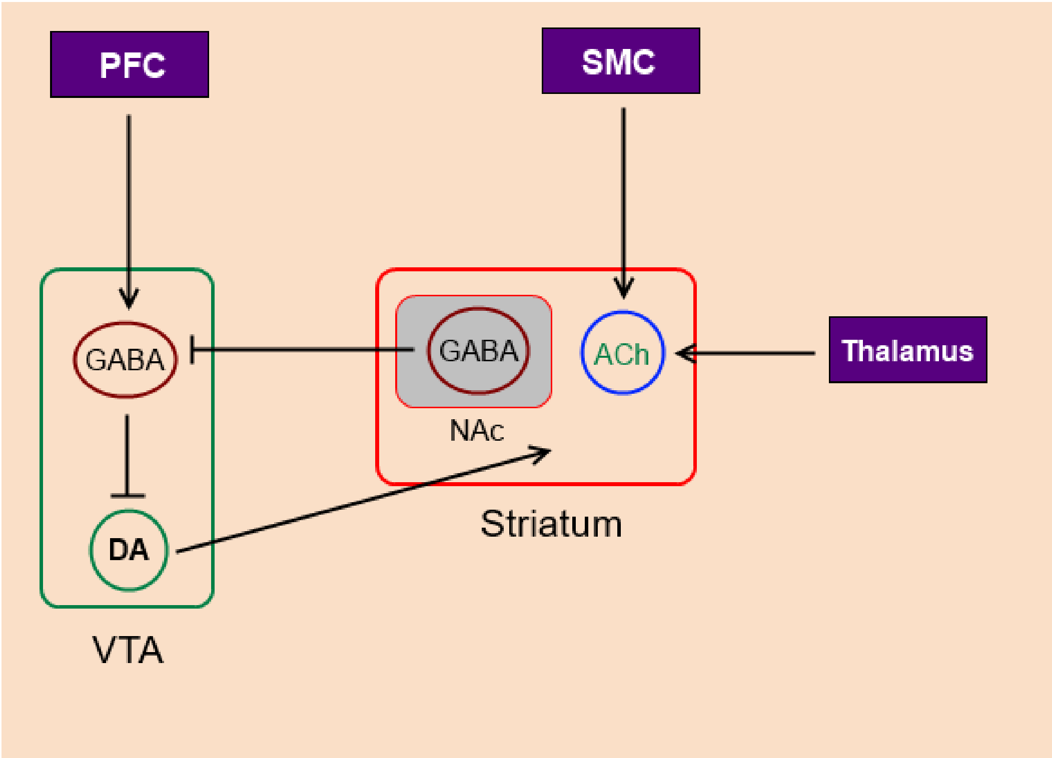

Figure 3. The neural circuit that can account for "seek pleasure, avoid pain." When the DA neurons of VTA fire, they release DA to the striatum, resulting in "GO" action. When the neurons of the thalamus and SMC fire, they stimulate the ACh neurons of the striatum to release ACh into the region, promoting the "No-GO" action. PFC: prefrontal cortex; SMC: sensorimotor cortex; NAc: nucleus accumbens.

DA and ACh have opposite effects on action selection. Decreased EM wave density reduces the probability of neuronal firing in all brain areas. How can the response in PFC leads to the same effect on action selection as in the thalamus and SMC? This is because neurons in the thalamus and SMC are directly connected to ACh neurons in the striatum (Lim et al., 2014).

However, the neurons of PFC are not directly connected to the DA neurons of VTA, but to the GABA neurons of VTA (Carr and Sesack, 2000). GABA neurons are inhibitory neurons that release GABA to inhibit connected neurons. As shown in Figure 3, firing of GABA neurons in VTA will inhibit DA release from its DA neurons to the striatum.

When a person feels happy, the brain activity generally decreases, so is the density of EM waves in the geon. Through microtubules, the reduced EM density attenuates the probability of neuronal firing. The attenuated neuronal firing in PFC will weaken the inhibitory effect of GABA neurons in VTA on DA neurons, thereby releasing more DA to the striatum. Attenuated neuronal firing in the thalamus and SMC reduces the concentration of ACh in the striatum. Therefore, during "liking", the changes in these three brain areas all lead to the "GO" action.

As discussed in Chapter 8, direct stimulation of NAc by electric current will result in "wanting". This finding can also be explained by the neural circuit in Figure 3. The human striatum contains approximately 100 million neurons, 90% of which are GABA neurons. The GABA neurons of NAc project to GABA neurons of VTA. Thus, stimulation of NAc inhibits the GABA neurons of VTA, thereby activating the DA neurons of VTA to release more DA to the striatum, consequently resulting in "GO" action.

Hyperdirect Pathway

It is important to note that the hyperdirect pathway does not pass through the striatum. Therefore, it is independent of feeling. This pathway depends on social norms and personal morals which are acquired by learning, not instinctual nature. With the hyperdirect pathway, human behavior is not necessarily governed by "seek pleasure, avoid pain". As an example, a young and beautiful girl is just hired by a company. The nature of male colleagues is to pursue. Some male colleagues are already married. For most people, the fact of "married" is sufficient to initiate the hyperdirect pathway to suppress the "GO" action. Unfortunately, some people can't resist the temptation, either the direct pathway is too strong and/or the hyperdirect pathway is too weak. They still insist on chasing the girl, even at the risk of divorce.