

The Philosophy of the Shape, The Neuron' Shape is a Necessity

The shape of cell body (the stoma) of the motor neuron is starlike. It consists of many arches that look outward. Whereas, the shape of the sensory neurons' cell body is too simple. It is oval or spherical.

In the following, I am trying to find out the relation between the form of the neuron and its main function. In another sense, to find out the function's impact on the form choice.

1. The Basic Neuron Types

There are three different neuron types. The unipolar neurons, which are the sensory neurons. The bipolar neurons, such as the olfactory receptor neurons and the photoreceptor neurons. The multipolar neurons that are the motor neurons.

The multipolar neurons adapt the starlike shape for their cell bodies. While, the other two neuron types simply prefer the oval and the spherical shape for the cell body; **figure (1)**.

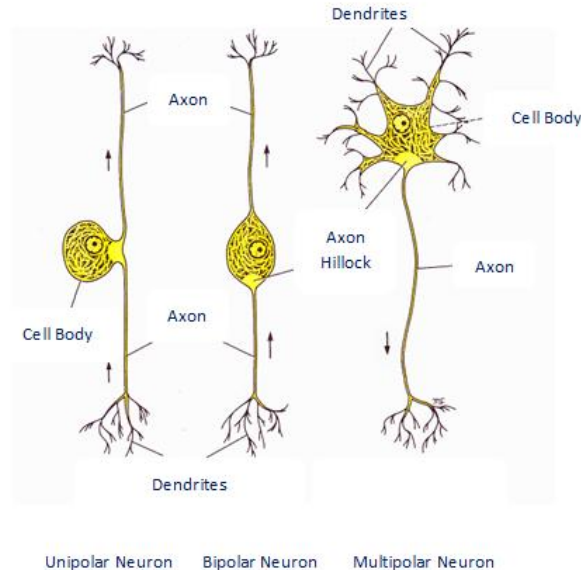


Figure (1)

The Basic Neuron Types

There are three different neuron types (unipolar, bipolar and multipolar neurons). The multipolar neurons, mainly are the motor neurons. The bipolar neurons are the sensory neurons that conduct the sense of touch and of temperature for example. The unipolar neurons, mainly are the olfactory receptor neurons and the photoreceptor neurons. The shape of cell body is starlike for the multipolar motor neurons, and oval or spherical for the both sensory neurons.

2. The Pressure Wave and the Neural Conduction in Neural Fibers

To understand the philosophy of the form, it becomes necessary to change the ancient conception of neural conduction, and let place to another idea to come. Therefore, I advise you to read my new conception regarding the neural conduction in the neural fibers^{*}.

In my article, I did emphasize the role of the pressure wave in the neural conduction. The action pressure wave, which is an innovated term, is built up in the axon hillock of the motor neurons. While, it is built up on the periphery at the root of the dendrites in the sensory neurons^{**}.

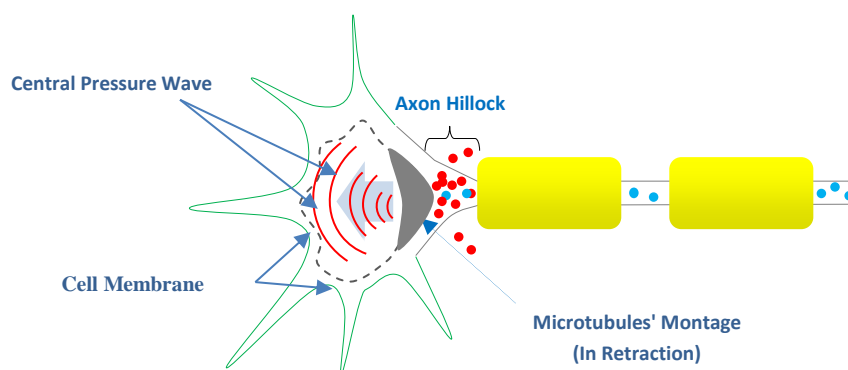
The action pressure wave has two components; the crest and the trough. The trough is of a negative pressure. Coming soon after the crest, the trough plays the essential role in the generating of the electrical neural current. The mechanism of such function, and of many others, are detailed and are quite illustrated in the pre-mentioned article^{*}.

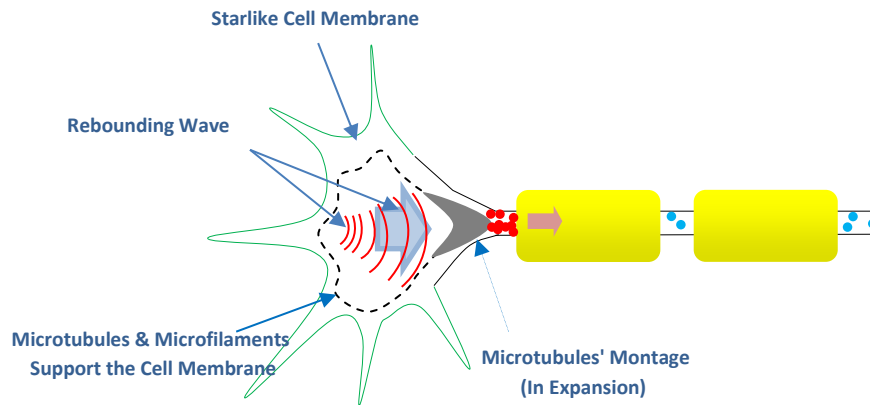
3. The Central Pressure Wave

This innovated term only concerns the neural conduction in the motor neurons. At the axon hillock, there is a specific montage of microtubules in a form of a pyramid. The apex of the pyramid slightly protrudes in the lumen of the axon just at its beginning.

Upon reaching the threshold, the montage of the microtubules contracts creating a pressure impulse that spreads backward into the cytoplasm of the neuron's cell body; **figure (2-A)**.

Then, the central pressure wave rebounds off the armed cell membrane of the cell body, and returns back to its point of origin in the axon hillock. Upon reaching the axon hillock, it yarely but forcefully pushes the montage of the microtubules toward the axon, thus creating the action pressure wave; **figure (2-B)**. The action pressure wave is the motor of the neural conduction in the neural fibers^{*}.





B

Figure (2)

The Central Pressure Wave

is

the starter of the Action Pressure Wave

In the motor neuron, the cell membrane of cell body is quite resistant. It is enforced with the elastic microtubules from inside, on one hand. On the other hand, its starlike shape with all the arches looking outward give it more resistance vis-a-vis the internal positive pressure alterations.

Figure (A) **The Charging Phase:** Upon reaching the threshold, the microtubules' montage contracts and proximally withdraws, thus creating a central pressure impulse (wide blue arrow). Too fast, the central pressure wave clashes the well-armed cell membrane of the cell body, and then it rebounds off.

Figure (B) **The firing Phase:** The microtubules' montage receives the rebounding pressure wave (wide blue arrow), and then yarely rushes into the lumen of the axon thus creating the famous action pressure wave (red arrow).

N.B. The red balls represent the positive Na^+ ions. The blue balls represent the intra cellular elements, i.e. the proteins, the vesicles, and the intra cellular ions.

4. In Motor Neurons, the Starlike Shape is an absolute Necessity

At rest as well as in action, the pressure inside the neuron is always positive. This positivity is essential for a perfect functioning of the different parts of the neuron. The internal positive pressure keeps the pathways of the neural conduction patent on permanent. These same pathways serve for the delivery of the other neural elements, such as the neural vesicles, as well.

Furthermore, an internal positive pressure is equivalent to a cellular cytoplasm quite compact and more dense. Hence, is more conducive to the action pressure wave, and to the neural electrical current as well.

Physically, the velocity of the neural conduction is proportionally correlated to the internal pressure. Since too fast is the neural conduction in the motor neuron, too high to be the pressure inside the lumen, at rest and in action as well.

Per se, the cell membrane of the motor neuron cannot tolerate the high values of the luminal pressure. Therefore, the cell membrane is equipped with the superposed myelin sheath in the neural fibers, and with the under-posed microtubules and microfilaments in the nodes of Ranvier ***.

However, in the cell body, the motor neuron has recruited two ingenious adaptations. Firstly, it has armed its cell membrane with the under-posed microtubules and microfilaments. Secondly, it has adopted the starlike shape for its cell membrane.

With its arches looking outward, the starlike cell body would be quite resistant vis-a-vis the internal pressure waves. Whatsoever is the magnitude of such waves, the cell membrane will be capable to reflect them, meanwhile guard the shape of the cell body; *figure (2-B)*.

5. In Sensory Neurons, the Shape is Marginal

However in the sensory neurons, the cell body does not play a such important role in the generating of the action pressure wave, nor in the generating of the electrical neural current. Both of them are built up at the root of the dendrites, then directly get the terminal branches via the axon **. Actually, the cell body will be out of the actual pathway of the neural conduction, and will be out of the harm of the luminal pressure alterations subsequently ; *figure (1)*.

Moreover, the velocity of the neural conduction in the sensory neurons most often is lesser than its homologue in the motor neurons. Consequently, the luminal pressure will be of a lesser magnitude at rest as well as in action.

For all the above reasons, the cell body of the sensory neuron will always be out of danger, and the mere cell membrane could guarantee the safety of the cell body. For the same reason, the simple oval or spherical shape could be suitable for the neuron' stoma (cell body).

5. The Form' Philosophy

Since the cell body is among the principal actors of the neural conduction and makes essential party of its theatre⁽¹⁾, the luminal pressure is of a considerable magnitude at rest⁽²⁾, and the luminal pressure is much more higher in action⁽³⁾, the motor neurons have adopted the most sophisticated starlike shape for their stomas. It is more resistant than the other forms vis-à-vis the luminal pressure alterations, which are of great magnitudes in the motor neurons.

In contrast, since the cell membrane could per se stand against the feeble positive luminal pressure at rest as well as in action, the cell' shape becomes marginal and does not merit a such or a such attention. Hence, the sensory neurons have humbly adopted the simple oval and the spherical figuration for their cell bodies. They are quite simple and quite sufficient.

(*) [" The Neural Conduction.. Personal View vs. International View "](#)

(**) [" The Sensory Receptors.. Innovated Conception "](#)

(***) [" The Node of Ranvier, The Equalizer.. Innovated Conception "](#)

In the same context, one could read:

- [The Neural Conduction in the Synapses \(Innovated Conception\)](#)

- [The Philosophy of Pain, Pain Comes First \(Innovated Conception\)](#)
- [The Philosophy of Form, \(Innovated Conception\)](#)
- [The Spinal Injury, the Pathology of the Spinal Shock, the Pathology of the Hyperreflexia \(Innovated Conception\)](#)
- [The Nerve Conduction Study, The Wrong Hypothesis is the Origin of the Misinterpretations \(Innovated Conception\)](#)
- [The Wallerian Degeneration, Attacks the Motor Axons of Peripheral Nerve, while Conserves its Sensory Axons\(Innovated Conception\)](#)

20/9/2018