Difference Between EPSP and IPSP

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Key Difference - EPSP vs IPSP

The nervous system is important when responding to different stimuli received by the nerve cells. Both biological and electrochemical components are involved with the signal transmission by the nervous system. Different potentials that build up within the nervous system components cause the transmission of different nerve stimuli. Such potentials include graded potentials, action potentials and resting potentials etc. All these potentials occur due to electrochemical changes that take place. Out of different potentials, the graded potential is composed of different components such as slow wave potentials, receptor potentials, pacemaker potentials and post-synaptic potentials. EPSP and IPSP are two types of post-synaptic potentials. EPSP stands for excitatory post-synaptic potential and IPSP stands for inhibitory post-synaptic potential. In simple terms, **EPSP creates an excitable state at the post-synaptic membrane that has the potential to fire an action potential whilst IPSP creates a less excitable state that inhibits the firing of an action potential by the post-synaptic membrane.** This is **the key difference** between EPSP and IPSP.

What is EPSP?

EPSP is referred to excitatory post-synaptic potential. It is an electrical charge that occurs within the post-synaptic membrane of the neuron as a result of excitatory neurotransmitters. It induces the generation of the action potential. In other terms, EPSP is the preparation of the post-synaptic membrane to fire an action potential. The generation of an action potential by the post-synaptic membrane occurs through a sequential process with the involvement of different neurotransmitters and ligand-gated ion channels. The neurotransmitters that are excitatory release from the vesicles of the pre-synaptic membrane and enter into the post-synaptic membrane.

The major neurotransmitter that enters the post-synaptic membrane is glutamate. Aspartate ions also can act as an excitatory neurotransmitter. Once entered, these neurotransmitters bind to the receptors of the post-synaptic membrane. Binding of neurotransmitters results in the opening of ligand-gated ion channels. The opening of the ligand-gated ion channels causes the flow of positively charged ions, mainly sodium ions (Na^+), into the post-synaptic membrane.

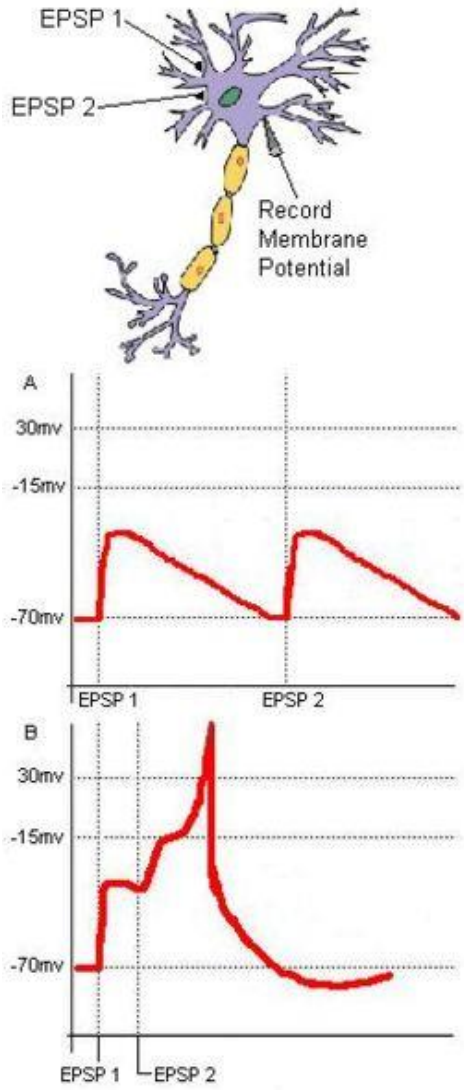

Figure 01: EPSP

The movement of these positively charged ions creates a depolarization at the post-synaptic membrane. In other terms, EPSP creates an exciting environment within the post-synaptic membrane. This excitation results in the firing of an action potential by directing the post-synaptic membrane towards the threshold level.

What is IPSP?

IPSP is referred to as the inhibitory post-synaptic potential. It is an electrical charge that builts up in the post-synaptic membrane inhibiting the firing of an action potential. This is the exact opposite of EPSP. The major reason for the development of IPSP is a sequential step process that involves inhibitory neurotransmitters binding to the post-synaptic membrane receptors. These neurotransmitters include Glycine and Gamma-Amino Butyric Acid (GABA), which are secreted by the pre-synaptic membrane. GABA is an amino acid that acts as a most prevalent inhibitory neurotransmitter in the central nervous system. Upon release, GABA binds to receptors such as GABAA and GABAB present in the post-synaptic membrane. When these inhibitory neurotransmitters bind, it results in the opening of ligand-gated ion

channels that cause the movement of chloride ions (Cl-) into the post-synaptic membrane.

These gated channels are commonly referred to as ligand-gated chloride ion channels. Chloride ions are negatively charged. These ions cause a hyperpolarization at the post- synaptic membrane. This means the ISPS creates an environment that has a very less probability of firing an action potential. This inhibitory process continues until the inhibitory neurotransmitters detach from the receptors of the post-synaptic membrane which they are bound to. Once detached, these neurotransmitters will fall back to their original locations resulting in the closure of ligand-gated chloride ion channels. No chloride ions will enter the post-synaptic membrane, and the membrane will enter into a state of equilibrium potential.

What are the Similarities Between EPSP and IPSP?

- Both are post-synaptic potentials and occur in the post-synaptic membrane.
- Both are mediated by ligand-gated ion channels.
- In both conditions, ligand-gated ion channels are opened by the binding of different neurotransmitter molecules.

What is the Difference Between EPSP and IPSP?

EPSP vs IPSP	
EPSP is an electrical charge that occurs within the post-synaptic membrane as a result of excitatory neurotransmitters and induces the generation of an action potential.	IPSP is an electrical charge that occurs within the post-synaptic membrane as a result of binding of non-excitatory or inhibitory neurotransmitters and prevents the generation of an action potential.
Polarization Type	
Depolarization occurs during the EPSP.	Hyperpolarization occurs during IPSP.
Effect	
EPSP directs the post-synaptic membrane towards the threshold level and induces an action potential.	IPSP directs the post-synaptic membrane away from the threshold level and prevents the generation of an action potential.
Type of Ligands Involved	
Glutamate ions and aspartate ions are involved during the EPSP.	Glycine and Gamma-Aminobutyric acid (GABA) are involved during the IPSP.

Summary - EPSP vs IPSP

EPSP is referred to as excitatory postsynaptic potential. It is an electrical charge that occurs within the post-synaptic membrane of the neuron as a result of excitatory neurotransmitters. EPSP creates an exciting environment within the post-synaptic

membrane. This excitation results in the firing of an action potential. IPSP is referred to as inhibitory postsynaptic potential. It is an electrical charge that built up in the post-synaptic membrane that inhibits the firing of an action potential. The major reason for the development of IPSP is a sequential step process that involves inhibitory neurotransmitters, which are bound to the post-synaptic membrane receptors. This inhibitory process continues until the inhibitory neurotransmitters detach from the receptors. This is the difference between EPSP and IPSP.

Reference:

1.Purves, Dale. “Excitatory and Inhibitory Postsynaptic Potentials.” Neuroscience. 2nd edition.,U.S. National Library of Medicine, 1 Jan. 1970. Available here
2.Robb, Amanda. “Inhibitory Postsynaptic Potential: Definition & Examples.” Study.com. Available here

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