Comparisons of the Parasympathetic and Sympathetic Autonomic Nervous Systems

Factor	Sympathetic	Parasympathetic
Outflow	Thoraco-Lumbar – between T1 and L2	Cranio-sacral – S2,3,4 and Cranial nerves: 3,7,9,10
Type of Neurone	Motor	Motor
Main time of control	When the body is preparing for action: fight, flight, fear response	When the body is at rest and is calm
Preganglionic neurones	Short axons, synapsing close to the CNS. Neurone is cholinergic, acting on nicotinic receptors on the postsynaptic membrane	Long axons, synapsing away from the CNS. Neurone is cholinergic, acting on nicotinic receptors on the postsynaptic membrane
Ganglia	Ganglia present in a 'sympathetic chain' either side of the vertebral column	Ganglia present close to or on target organs
Postganglionic neurones	Long axons, due to early synapsing. They are adrenergic, releasing nor adrenaline at the terminal end, which interacts with α and β adrenergic receptors.	Short axons, due to late synapsing. They are cholinergic, releasing acetylcholine at the terminal end which interacts with muscarinic receptors
Alternative transmitters	The adrenergic postganglionic axons also can release NYP. Some parasympathetic postganglionic axons are cholinergic acting on muscarinic receptors.	These cholinergic postganglionic axons are also able to release VIP at their terminal.
Receptor structure	Serpentine, with 7 transmembrane domains. Act through a second messenger amplification system via a G protein mechanism.	Serpentine, with 7 transmembrane domains. Act through a second messenger amplification system via a G protein mechanism.
Receptor antagonist	Atropine (muscarinic), atenolol (α-adrenergic)	Atropine
Response	Respond to stimulation from central	To reflex stimulation

	control centres	
Action	No specific efferent limb, response all over the body. No 1:1 synapsing	Specific efferent limb. No 1:1 synapsing
Tonic action?	Many experience continuous sympathetic tone – especially those innervating the blood vessels	No tonic action of such neurones. Neurones 'turn off' when not in use – except the tonic action to the heart from the vagus nerve.
Affect on the heart	Sympathetic stimulation causes the heart rate to increase and for the force of contraction to increase	Parasympathetic stimulation causes the heart rate to decrease ad for the force of contraction to decrease
How?	Adrenaline has the effect of increasing the rate of pacemaker depolarisation and an increased inward calcium current which results in a shorter but higher plateau on the action potential.	ACh has the effect of increasing the potassium permeability of the cells of the SA node which causes hyperpolarisation, so the I_F current takes longer to depolarise the membrane. The calcium current is also reduced, reducing force.