Faculty of veterinary medicine

UAB

FINAL DEGREE PROJECT

# SENSORIMOTOR SYSTEMS IN DOGS

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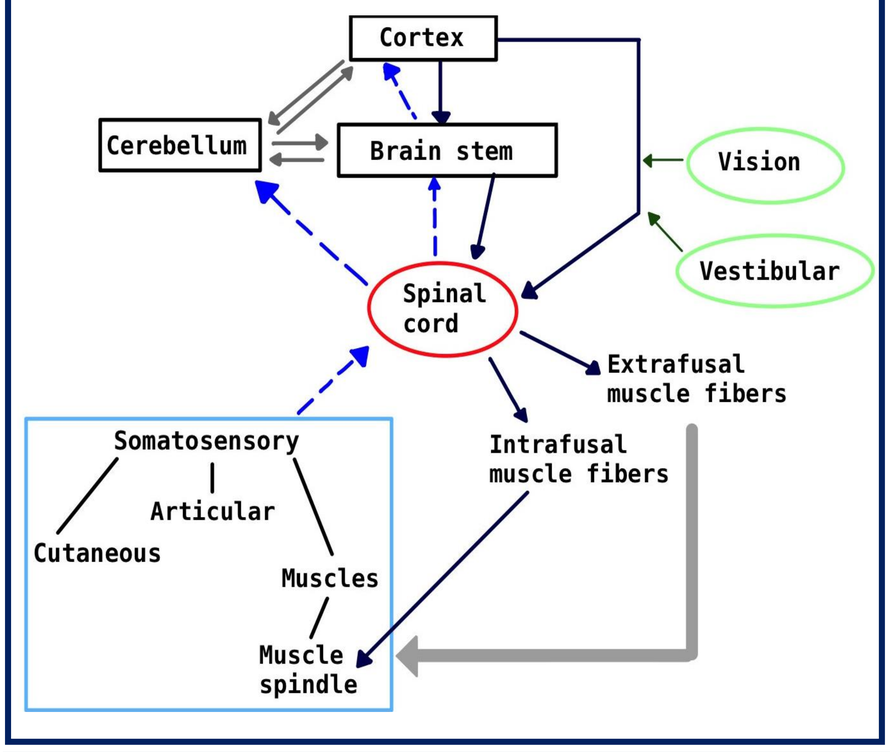
## OBJECTIVES

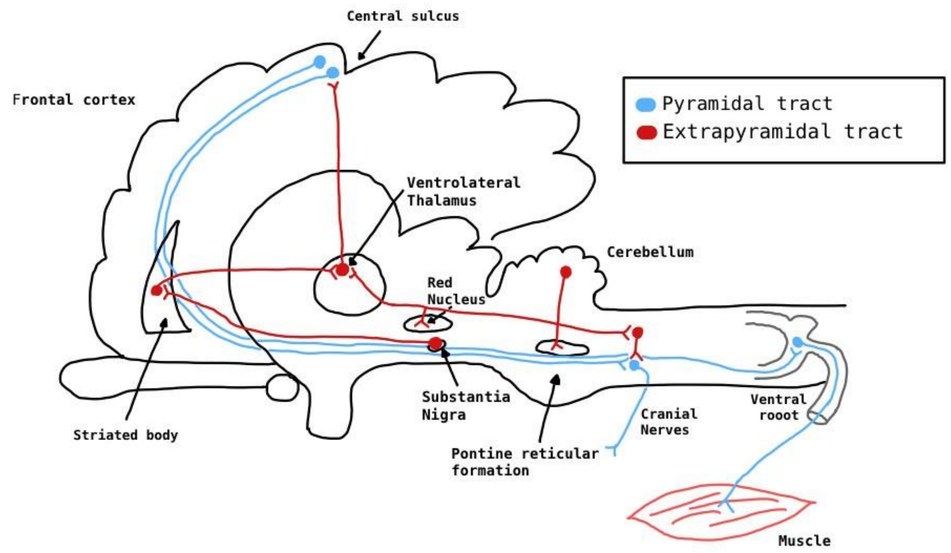
To explore the different components of the sensorimotor system in the canine species, how these components are connected to carry out different functions and how this system can be affected by different lesions and their consequences.

## SENSORIMOTOR SYSTEM COMPONENTS

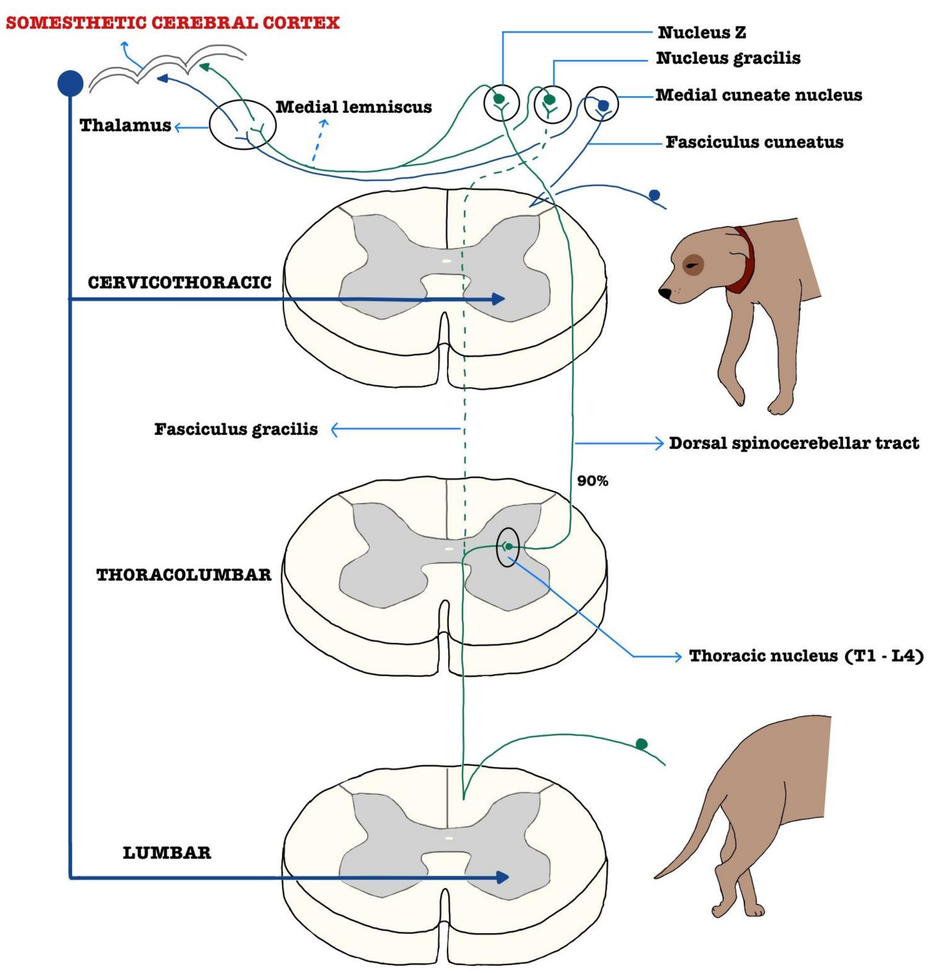



## MOTOR PATHWAYS

Sensory impulses reach the thalamus and the cerebellum. The thalamus projects into the sensory cerebral cortex, where information is integrated and sent to the motor cortex. The basal nuclei connect to the cerebral cortex and thalamus, with subthalamus, substantia nigra and dentate nucleus of the cerebellum. Once the information has been modulated in this circuit, it returns to the thalamus and to the motor cortex. Impulses are sent from the projection fibers of the motor cortex via the internal capsule to the nuclei of the brain stem and to the spinal cord to perform motor function.

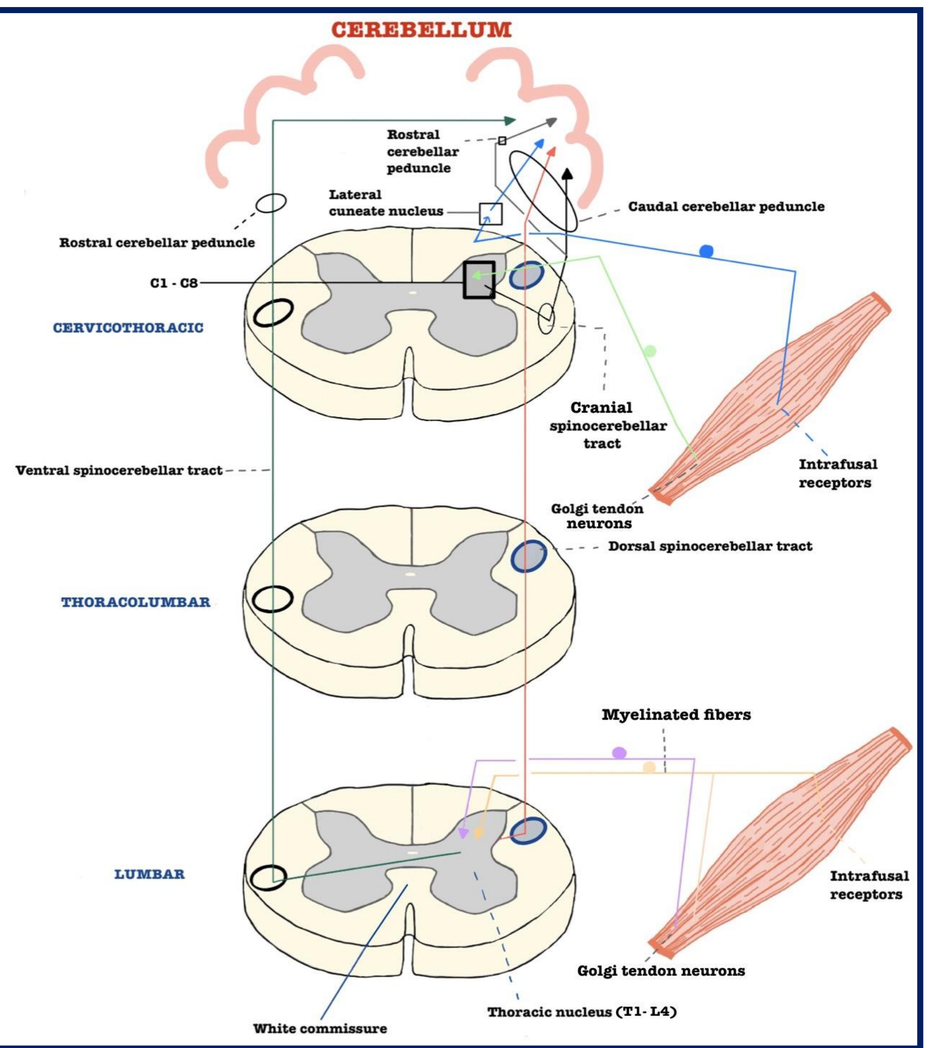



The pyramidal tract is a direct route (few interneurons are involved) which allows the execution of fine movements, while extrapyramidal tract is an indirect route in which several interneurons participate for the execution of less skillful movements and postural control.




## PROPRIOCEPTION

Proprioception is a sensory system that informs the brain and cerebellum about the static position and dynamics of the animal. There is a conscious or cerebral proprioception (represented in the diagram on the left), and an unconscious or cerebellar proprioception (represented in the diagram on the right). Proprioceptors are receptors located in the skeletal muscles (muscle spindle), tendons (Golgi tendon organ) and joints (perceiving joint movement). They detect stretching and variations in contraction, velocity and muscle tension, and inform the central nervous system of limb position, strength of movement and endurance.




## PAIN MODULATION

Pain sensation can be generated by several types of sensory modalities. Nociceptors detect mechanical, thermal, or chemical stimuli. The stimulus generated is transmitted as nociception and interpreted in the brain as pain. The impulses generated reach the spinal cord and are transmitted to brain through the spinothalamic, spinoreticular, spinomesencephalic tracts, and reticular formation. There are specific areas of the brain that participate on blocking of pain sensations in order to adapt to particular situations, such as the periaqueductal gray matter, that activates noradrenergic and serotonergic cells that excite neurons who release inhibitory neurotransmitters.

## SENSORIMOTOR SYSTEM LESIONS

(Source: Soren Boysen, 2015)

**Decerebrate posture:**
Lesions between the red nucleus and the vestibular nuclei lead to opisthotonos, hyperextension of the four limbs and severe decrease in consciousness.

(Source: Viktor Paluš, 2014)

**Decerebellate posture:**
Lesions in the rostral lobe of the cerebellum lead to extensor stiffness of the forelimbs, opisthotonos, and flexion of the hips, without alteration of consciousness

Lesions on cerebral cortex, basal nuclei or internal capsule, may affect in movement but do not cause paralysis, because sensory function and fine movements are impeded but not affect gait generation. However, lesions on brainstem affects motor function due to affection of the extrapyramidal pathways.

Lesions on forebrain causes deficits of proprioception with preserved motor activity, therefore, if there is a motor deficit (paralysis or paresis), the lesion should be located caudal to the forebrain.

Lesions of UMN causes paresis with hypertonia, spasticity and hyperreflexia due to the loss of regulatory function on muscle tone and reflexes. Lesions of LMN results in muscle weakness, paresis or paralysis, hypotonia, areflexia, or hyporeflexia, and muscle atrophy.

## CONCLUSION

It is a complex and precise system. Animal life is a continuous process of receiving stimuli, making decisions and generating responses. It is necessary to have a nervous system to be able to move, because without movement animals cannot feed, reproduce or respond to danger. The sensorimotor system makes movement possible, therefore, the sensorimotor system makes possible animal live.