The nictitating membrane

A transparent inner eyelid that protects and moistens the eye.

Rabbit

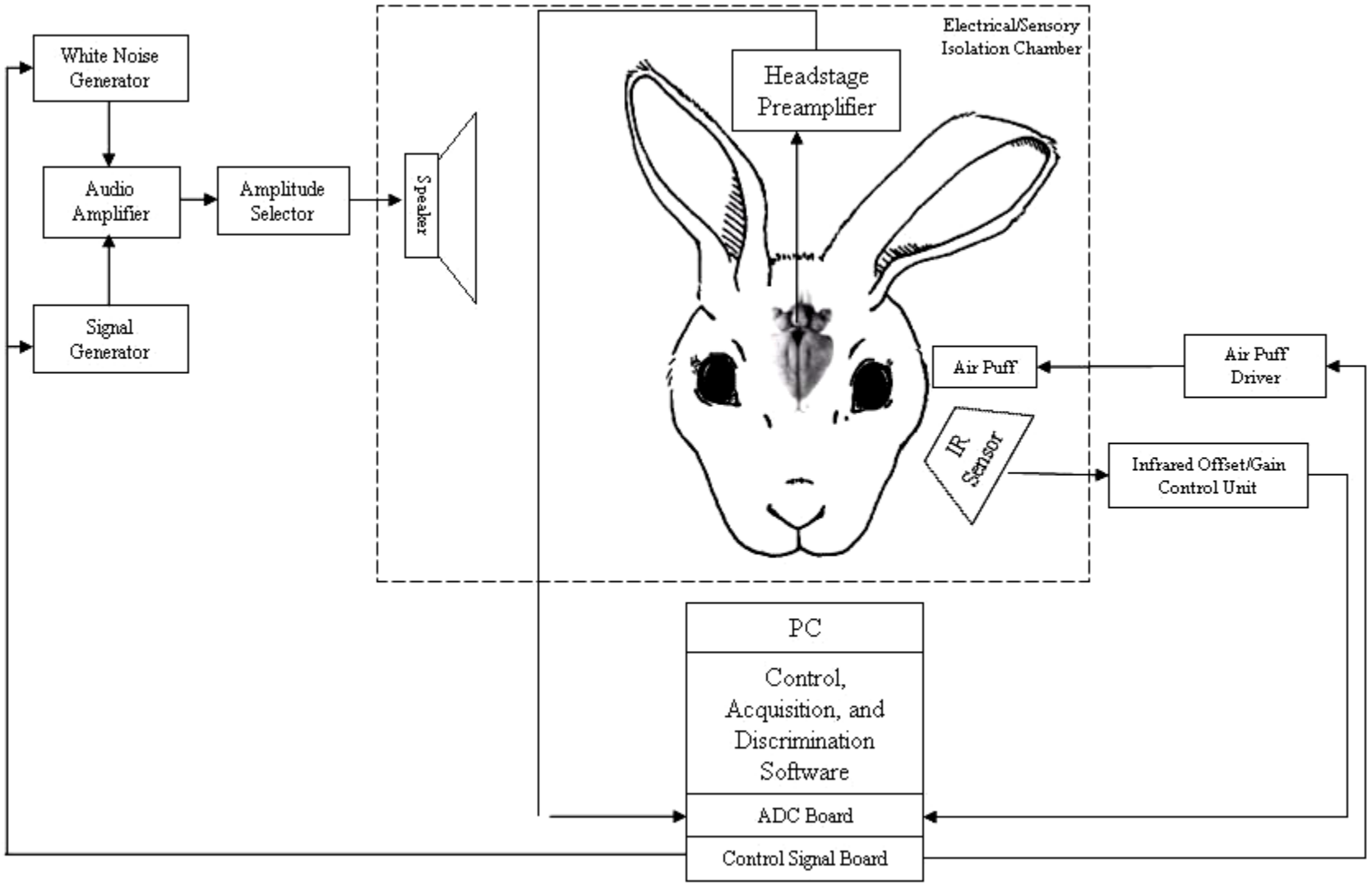
Shark

Owl

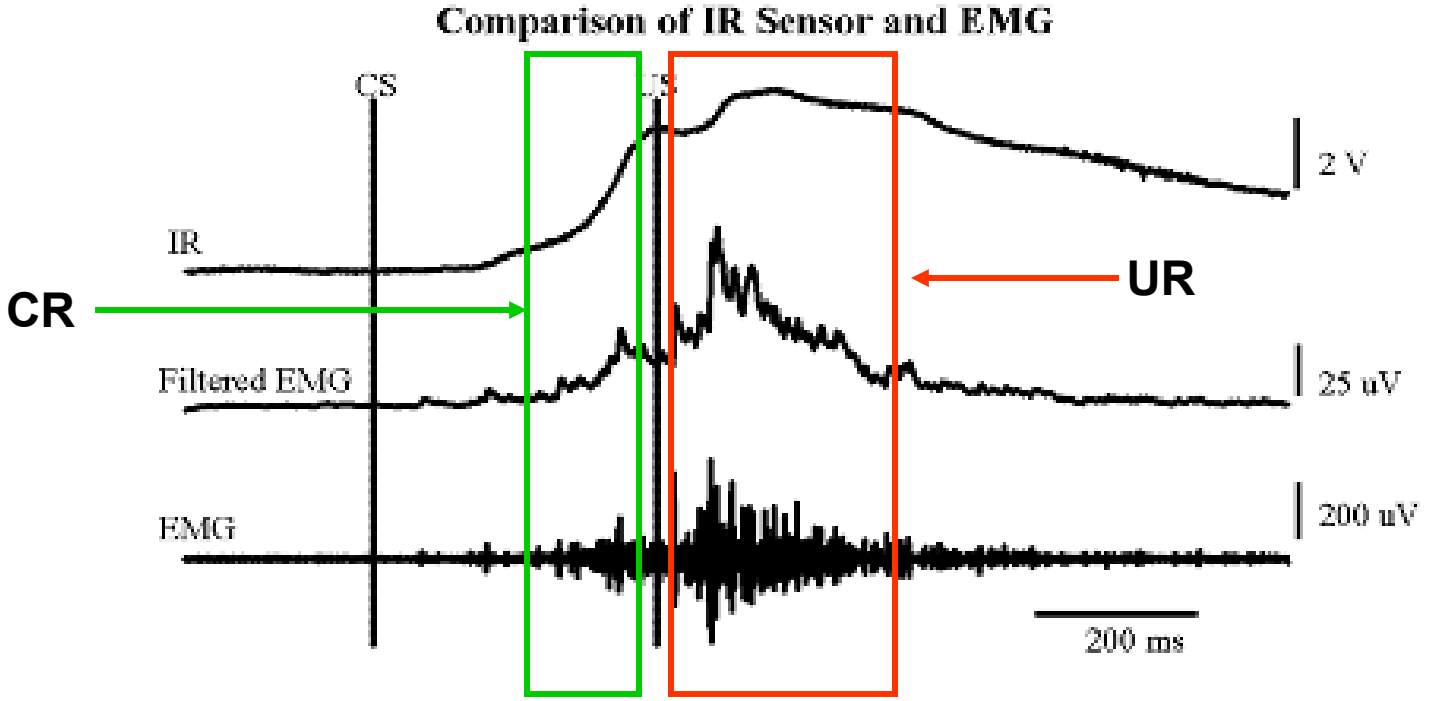
Chicken

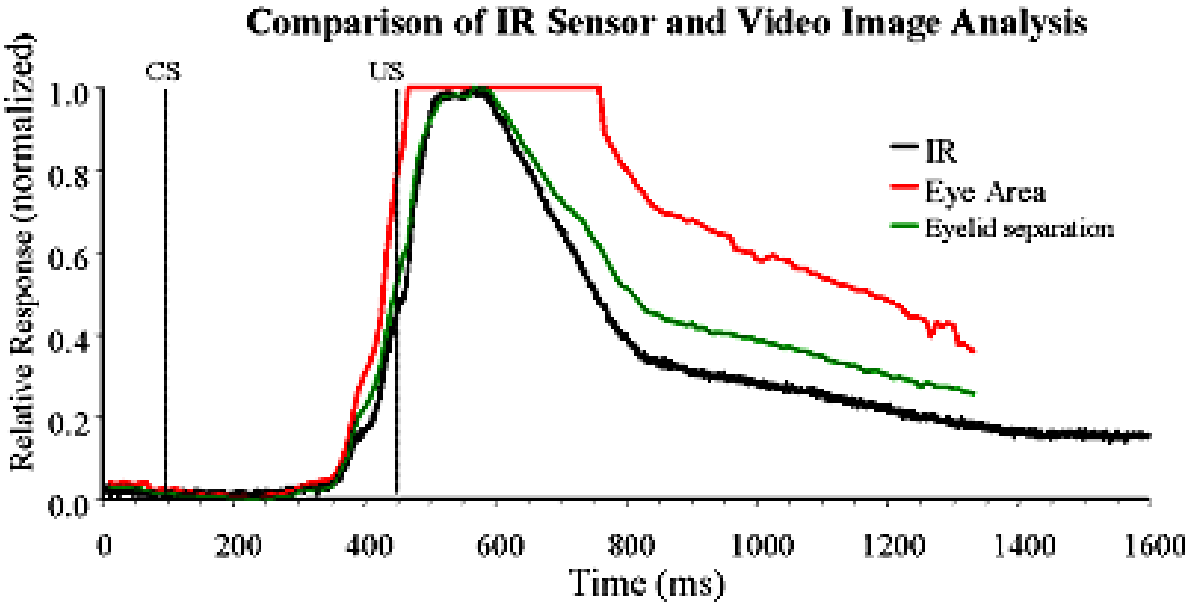
Frog

Nictitating membrane conditioning preparation



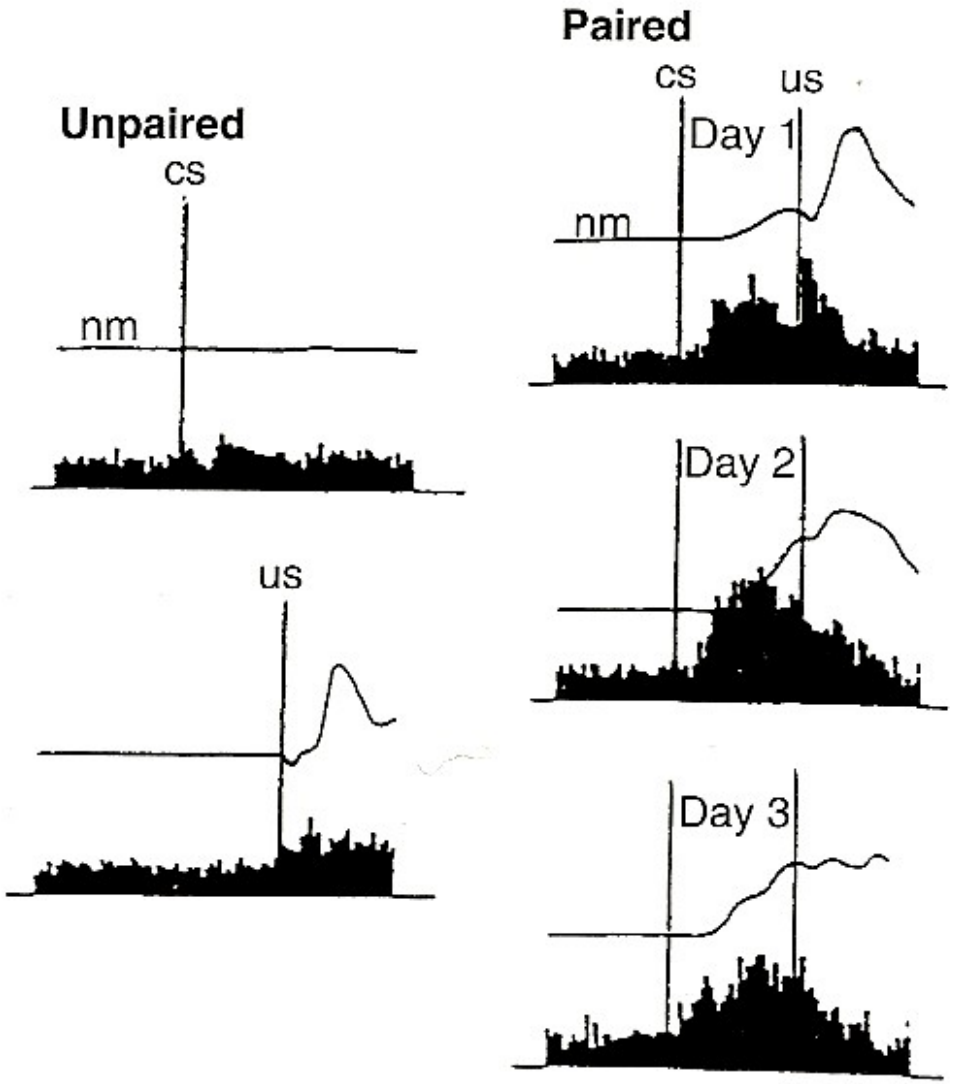
CR and UR





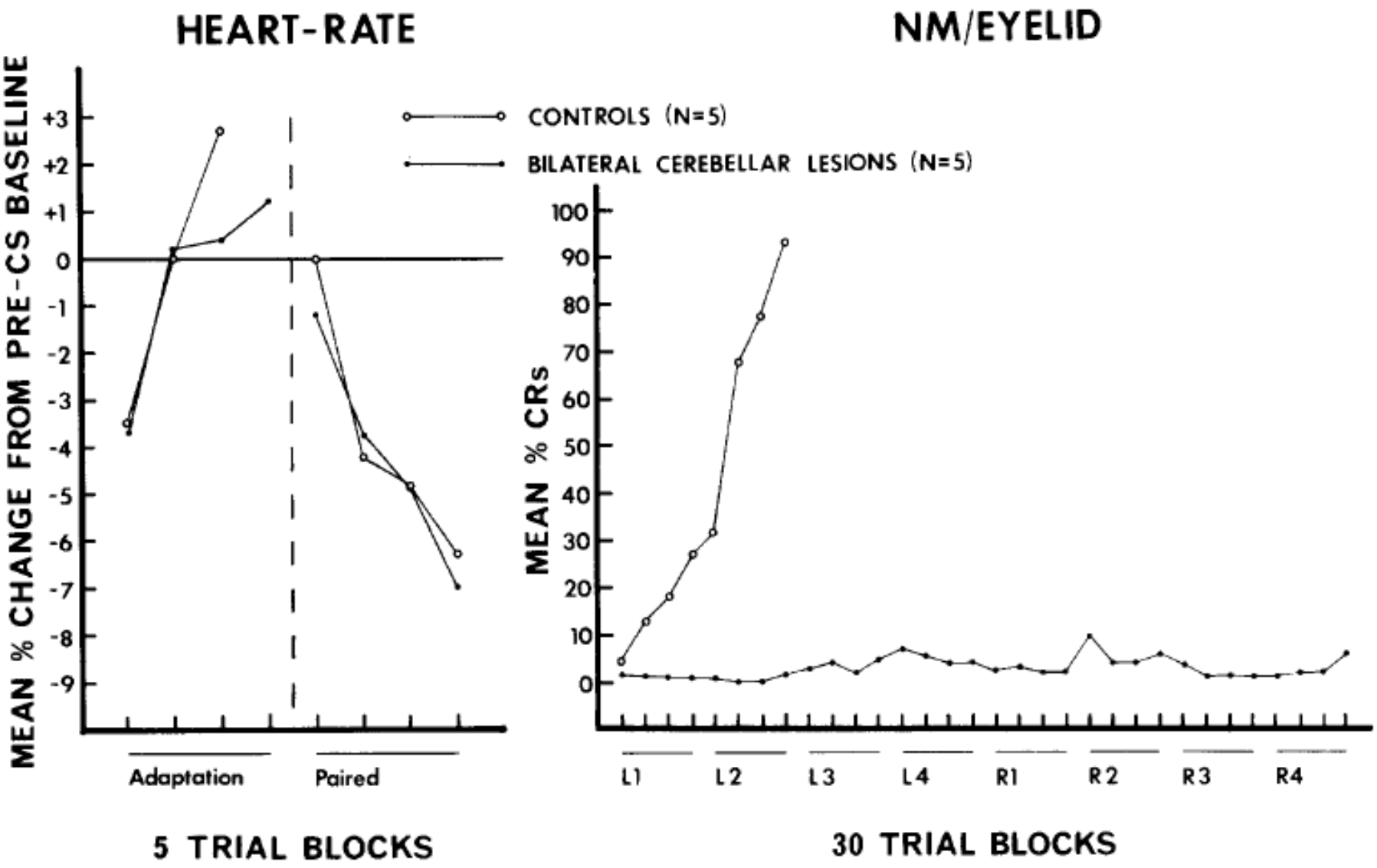
CS: conditioned stimulus
US: unconditioned stimulus
CR: conditioned response
UR: unconditioned response
IR: infrared sensor
EMG: electromyogram

Dentate and interpositus nuclei unit recordings during delay conditioning



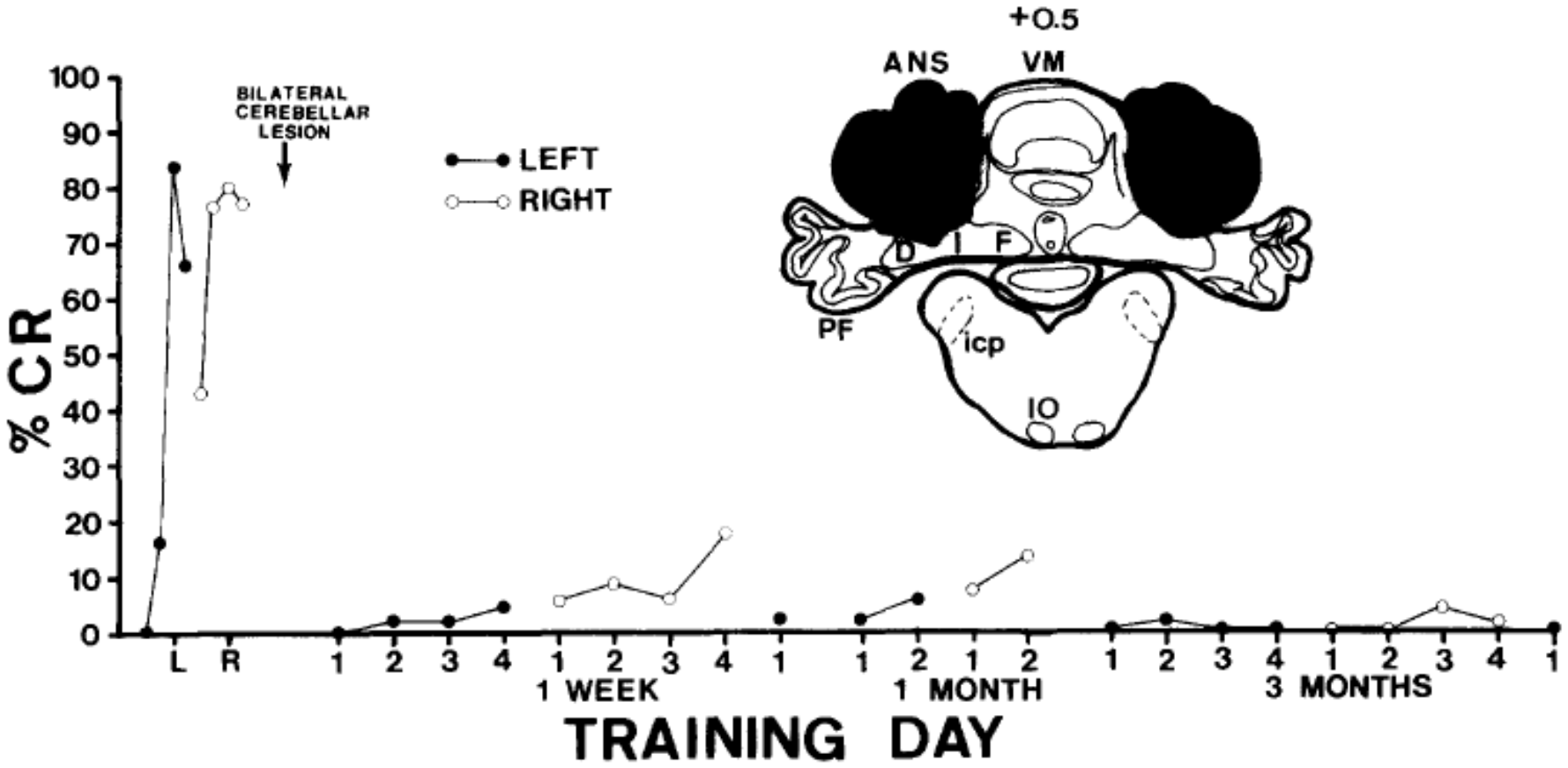
McCormick & Thompson, 1984, Journal of Neuroscience.

Bilateral lesions of the dentate and interpositus cerebellar nuclei and delay conditioning



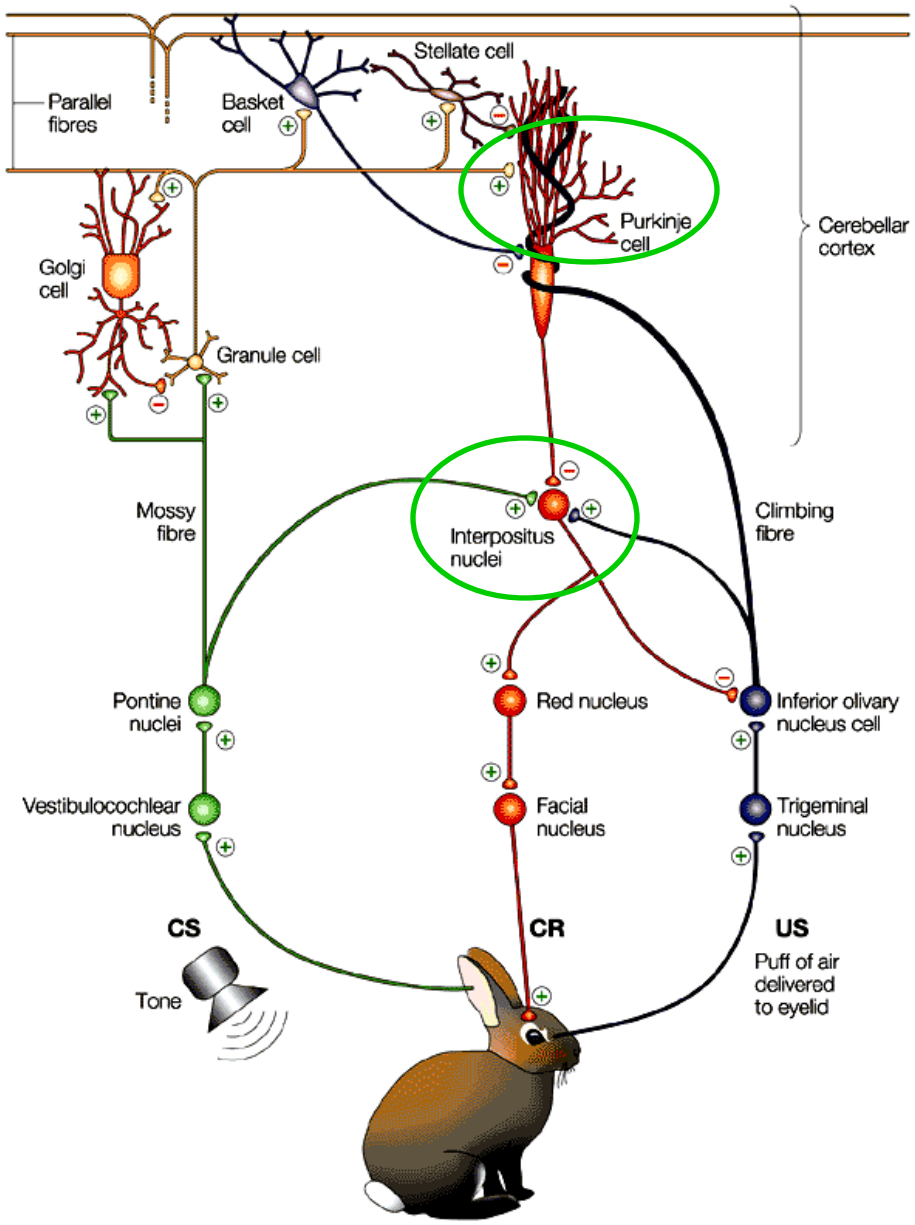
Lavond et al., 1984, Brain Research.

Bilateral lesions of the dentate and interpositus cerebellar nuclei and delay conditioning



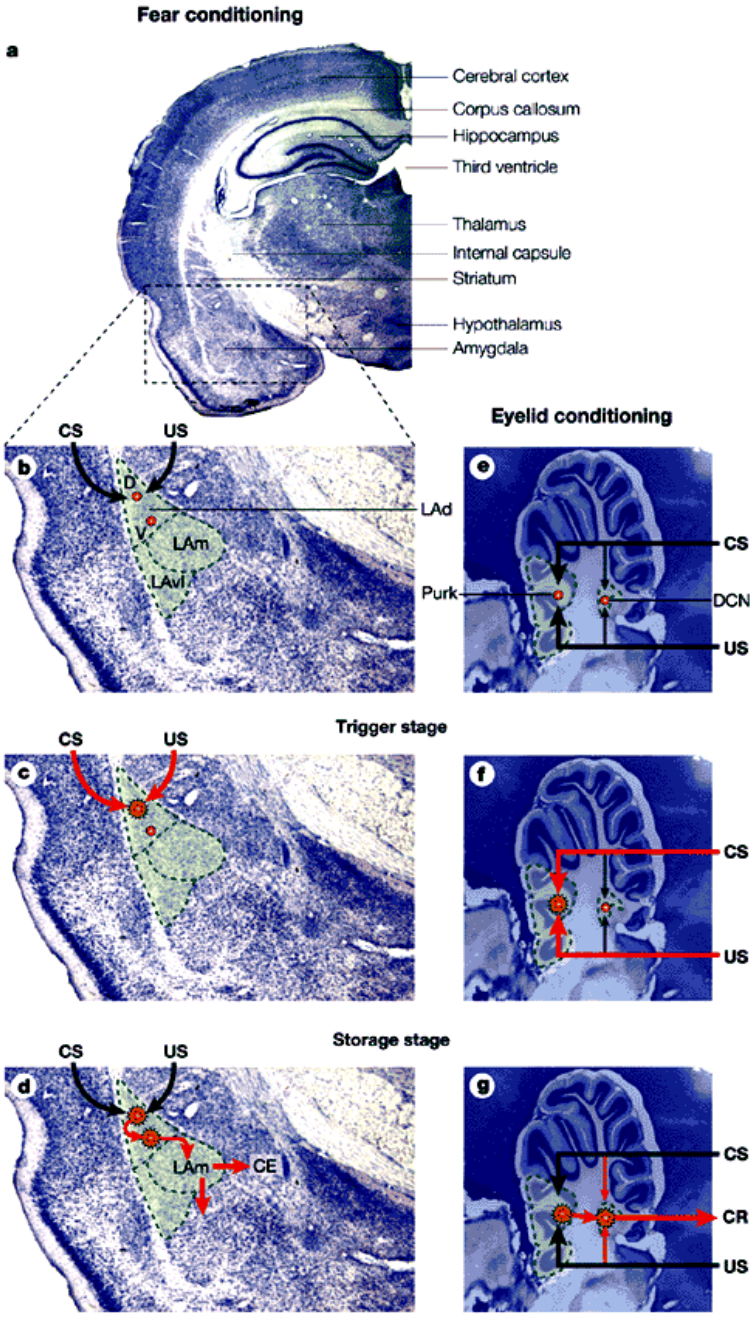
Lavond et al., 1984, Brain Research.

Brain circuit for nictitating membrane conditioning



The conditioned stimulus (CS) pathway is shown in green. In the case of a tone stimulus, it involves a mossy fibre projection that arises in the pontine nuclei and reaches both the interpositus neurons of the deep cerebellar nuclei and, through activation of granule cells, the Purkinje cells of the cerebellar cortex. The unconditioned stimulus (US) pathway is shown in blue. For an air-puff stimulus, it is transmitted to the same interpositus and Purkinje cells through activation of the climbing fibres that originate in the inferior olivary nucleus. The conditioned response (CR) leads to eyelid closure after exposure to the CS, and is generated by activation of the interpositus nucleus and its downstream targets, which include cells in the red nucleus and ultimately in the facial nucleus. Plus and minus signs indicate whether the particular connection is excitatory or inhibitory.

Comparing brain circuits for conditioning: Fear & NMC



a | Hemisection of the rat brain at the level of the amygdala (included within the dashed lines). **b** | The area of the amygdala is enlarged to show the three main subdivisions of the lateral nucleus: dorsal (LAd), medial (LAm) and ventrolateral (LAvl). The conditioned and unconditioned stimuli (CS and US) converge on single cells in the LAd. **c** | During the trigger stage of fear conditioning, convergence of the CS and US initiates rapid but transient plasticity in cells of the dorsal LAd. **d** | The induction of plasticity in the dorsal (D) LAd leads to more slowly acquired, longer-lasting changes in the storage cells of the ventral LAd. Ventral (V) LAd cells would then communicate with LAm cells that project to the central nucleus of the amygdala (CE) and are responsible for driving the CR. **e** | The CS and US used in eyelid conditioning converge on the Purkinje cells of the cerebellar cortex (Purk), as well as on the interpositus cells of the deep cerebellar nuclei (DCN). **f** | According to the 'trigger-and-storage' model of eyelid conditioning, plasticity is first induced in the Purkinje cells, even before any conditioned responses can be detected. **g** | Subsequently, plasticity is induced in the interpositus nucleus, which is responsible for the long-term storage of memory and the expression of the conditioned eyelid response.

Medina et al., 2002, Nature Reviews Neuroscience.

Coincidence detectors