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F França de Barros, C Taillebuis, M. Manuel, H. Bras, D Combes, et al.. Central pattern generator-driven efference copy couples eye movements with forelimb locomotion in mice. 2019 annual meeting Society for Neurosciences, Oct 2019, Chicago, United States. hal-02413495

HAL Id: hal-02413495

<https://hal.science/hal-02413495v1>

Submitted on 16 Dec 2019

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Central pattern generator-driven efference copy couples eye movements with forelimb locomotion in mice

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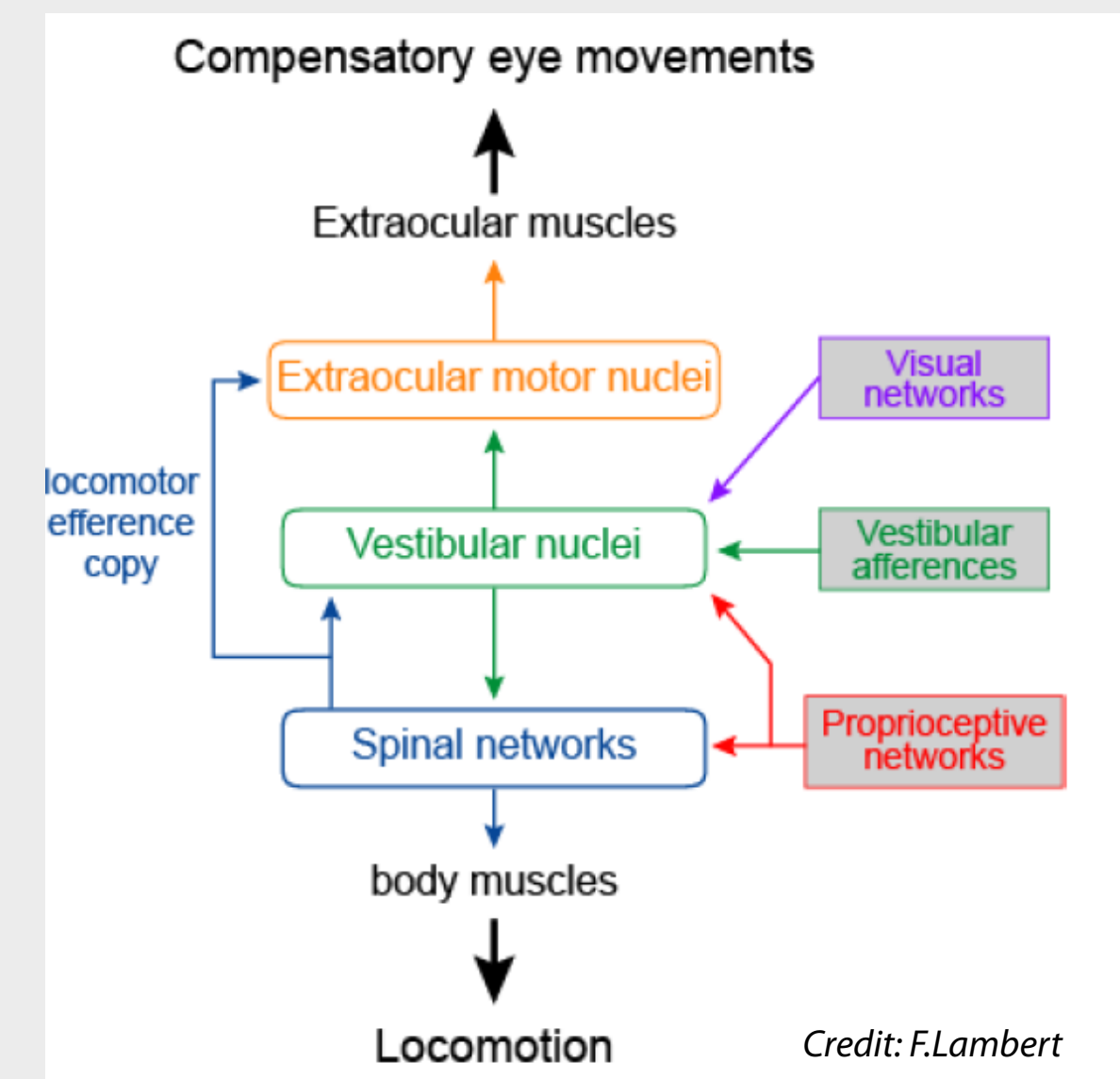
Presentation 062.11

Rational

Efference copies are neural replicas of motor outputs used to anticipate the sensory consequences of a self-generated motor action.

They are responsible for the coordination of motor behaviors by generating intrinsic feed-forward signals that directly connect a local motor circuitry with another local circuitry involved in another motor behaviour.

An example of a predictive motor efference copy is the signal originating from the locomotor spinal CPG that is simultaneously responsible for tail undulation as well as for driving eye movements during swimming in the *Xenopus* tadpole.



Aim

Study whether the CPG-driven predictive signal coupling eye movements to locomotion is preserved in mammals.

Conclusion

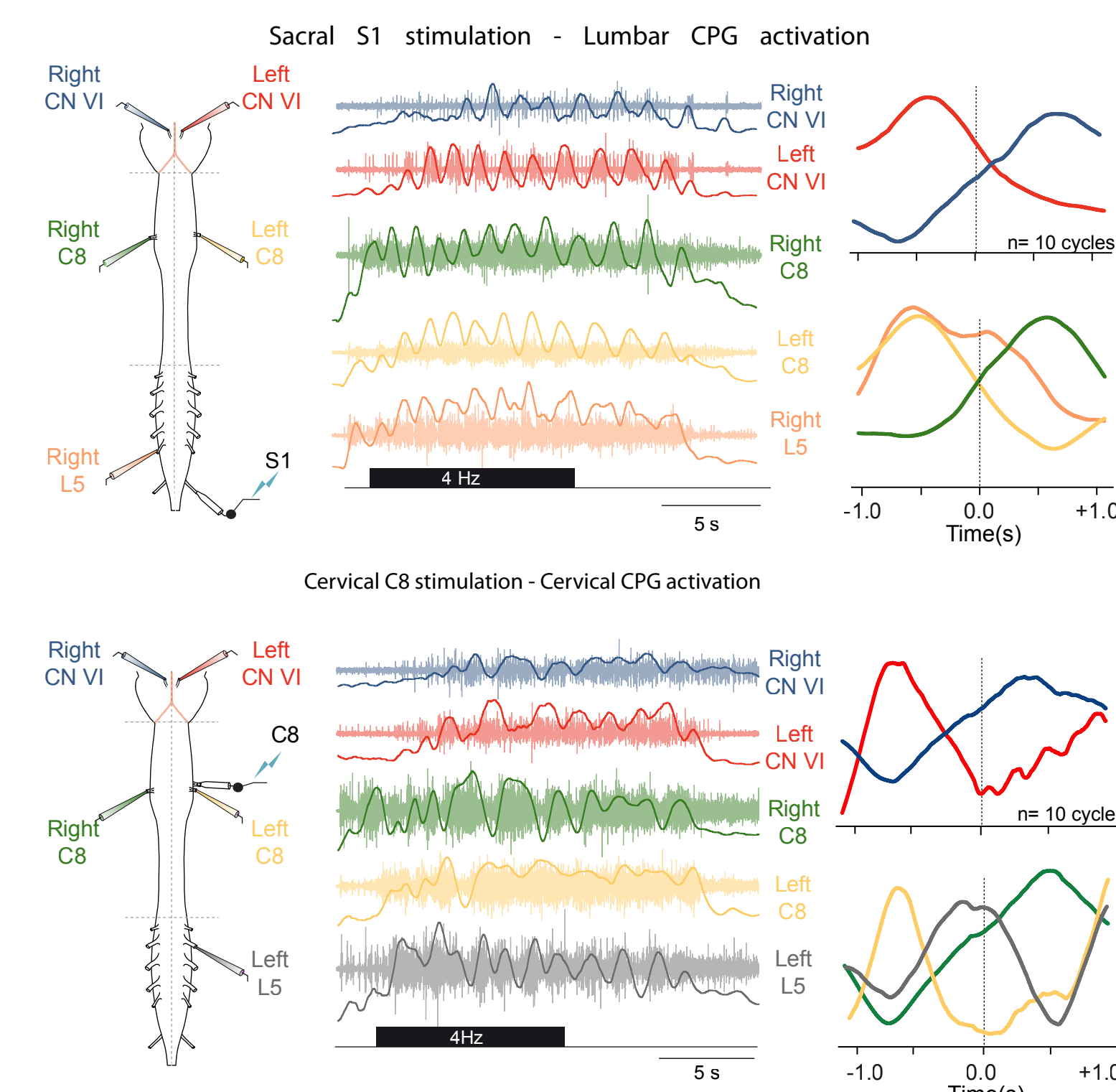
1. *Ex vivo*: rhythmic coupled discharge was found between limb and abducens motor nerve activity during fictive locomotion events elicited by both electrical and pharmacological stimulation.

2. *In vivo*: in absence of visual and vestibular inputs, conjugated eye movements are coupled to locomotion were recorded, suggesting that the efference copy participates in gaze stabilization during vigorous locomotion.

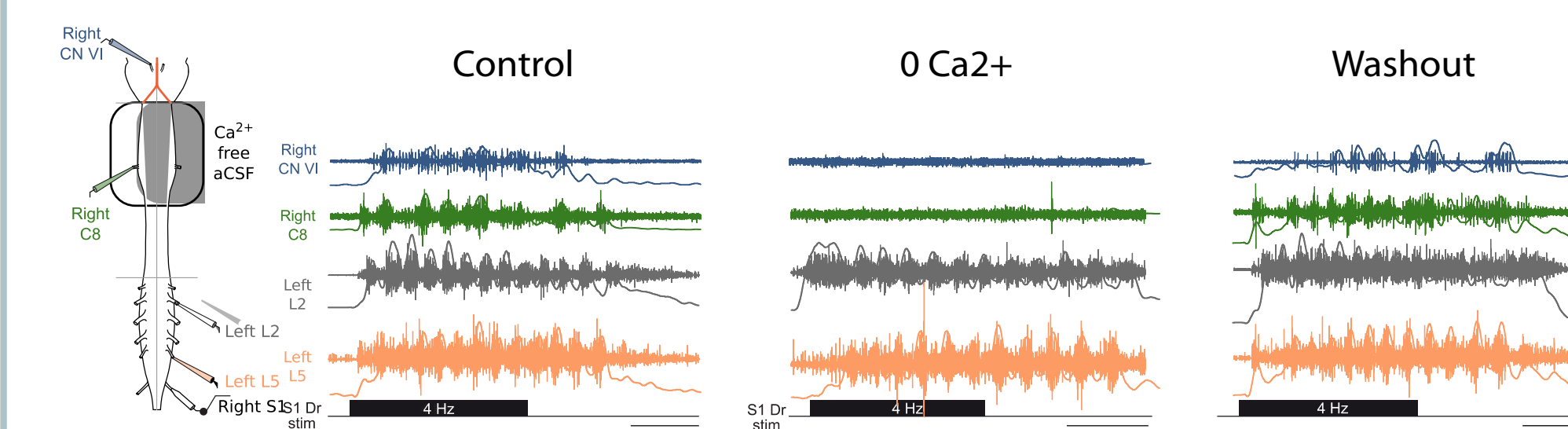
3. Anatomy: rabies virus injection revealed ipsilateral monosynaptic ascending spinal connection from the cervical with abducens motoneurons.

Ex vivo recordings of the eye's motor nuclei and locomotor CPGs in brainstem-spinal cord preparations of neonatal mice

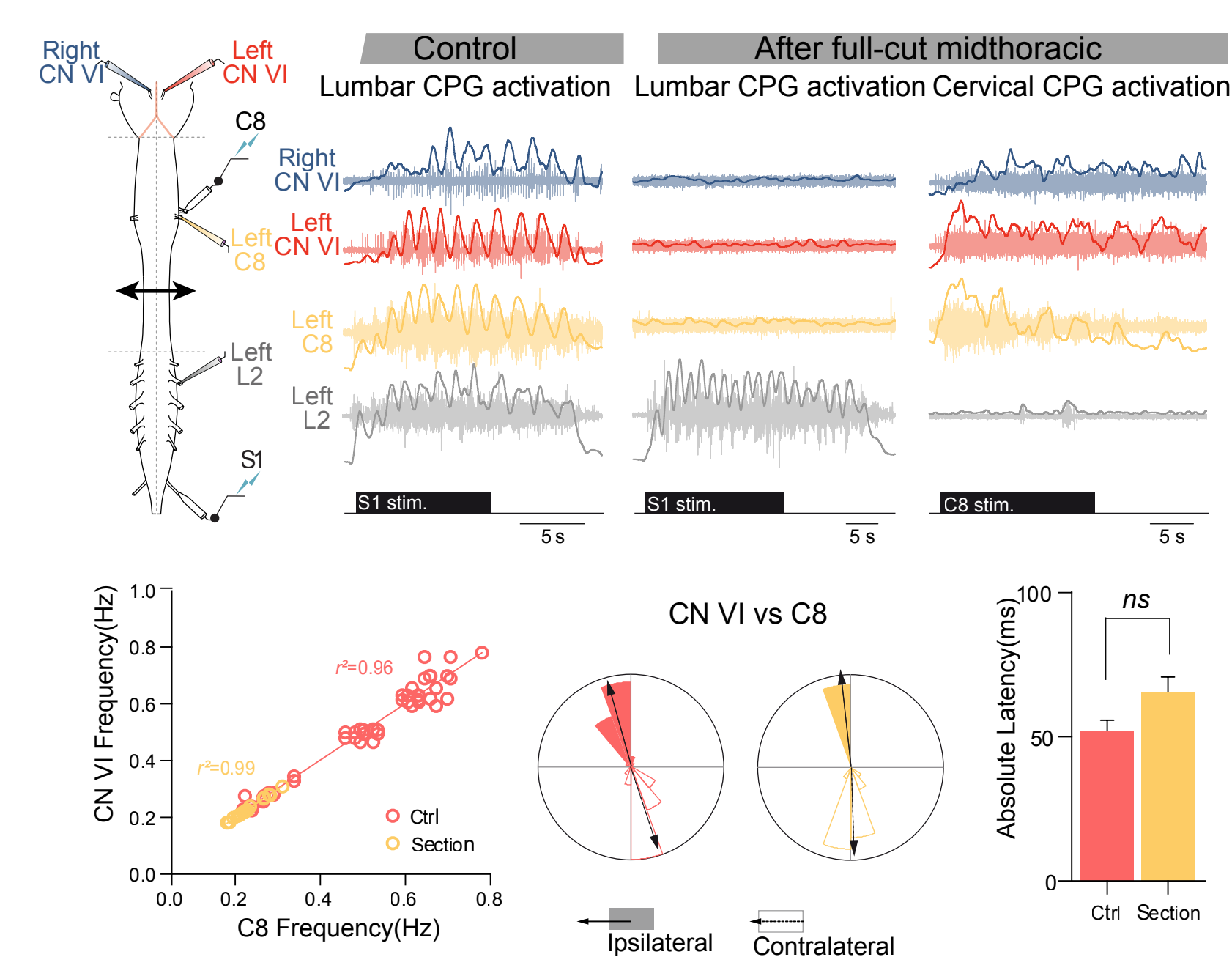
1. The extra-ocular activity is coupled to fictive locomotion



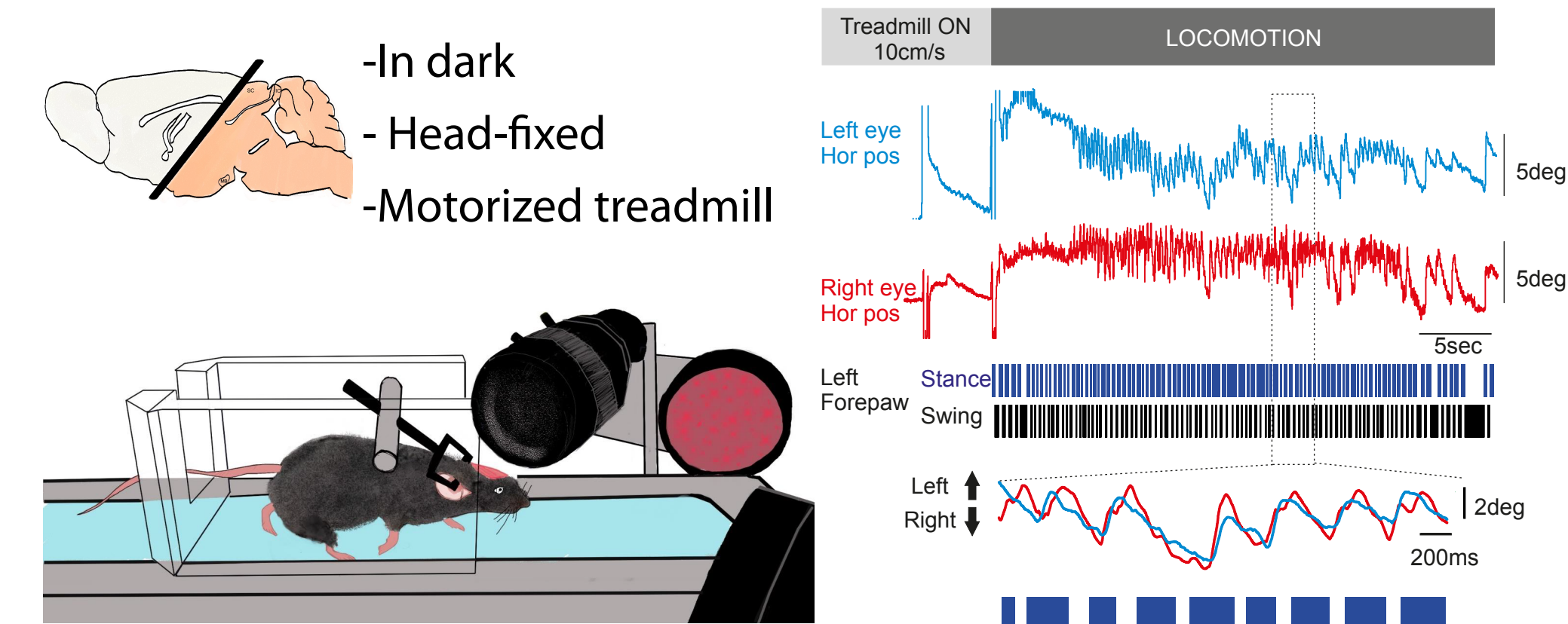
2. Blocking the cervical locomotor network removes the spino-extraocular coupling



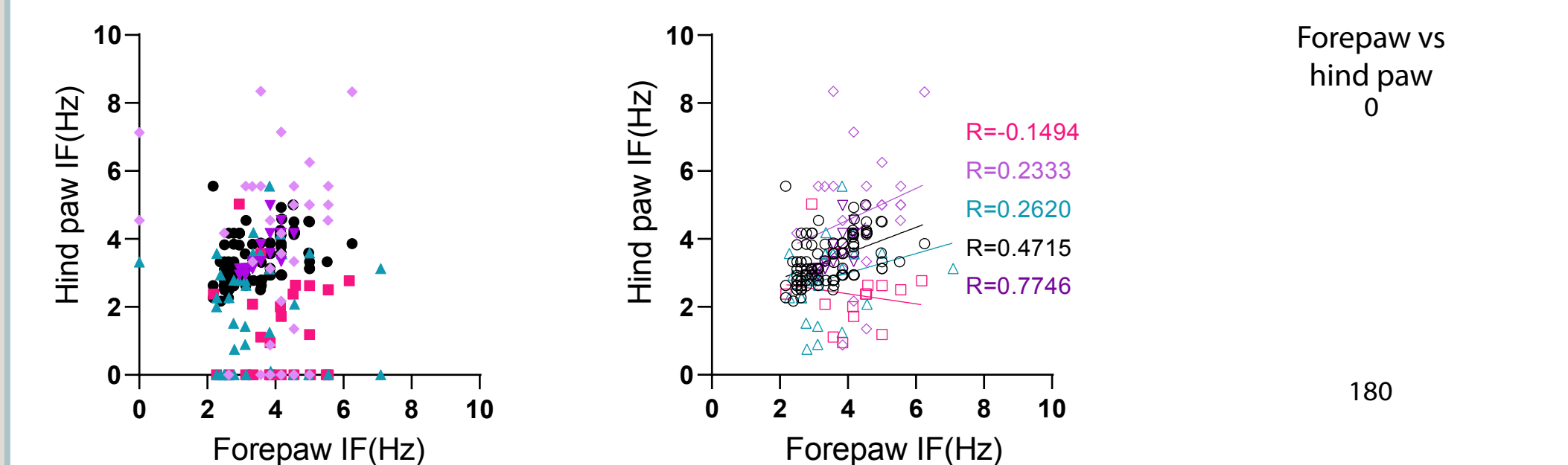
3. The cervical locomotor network is sufficient to produce the spino-extraocular coupling



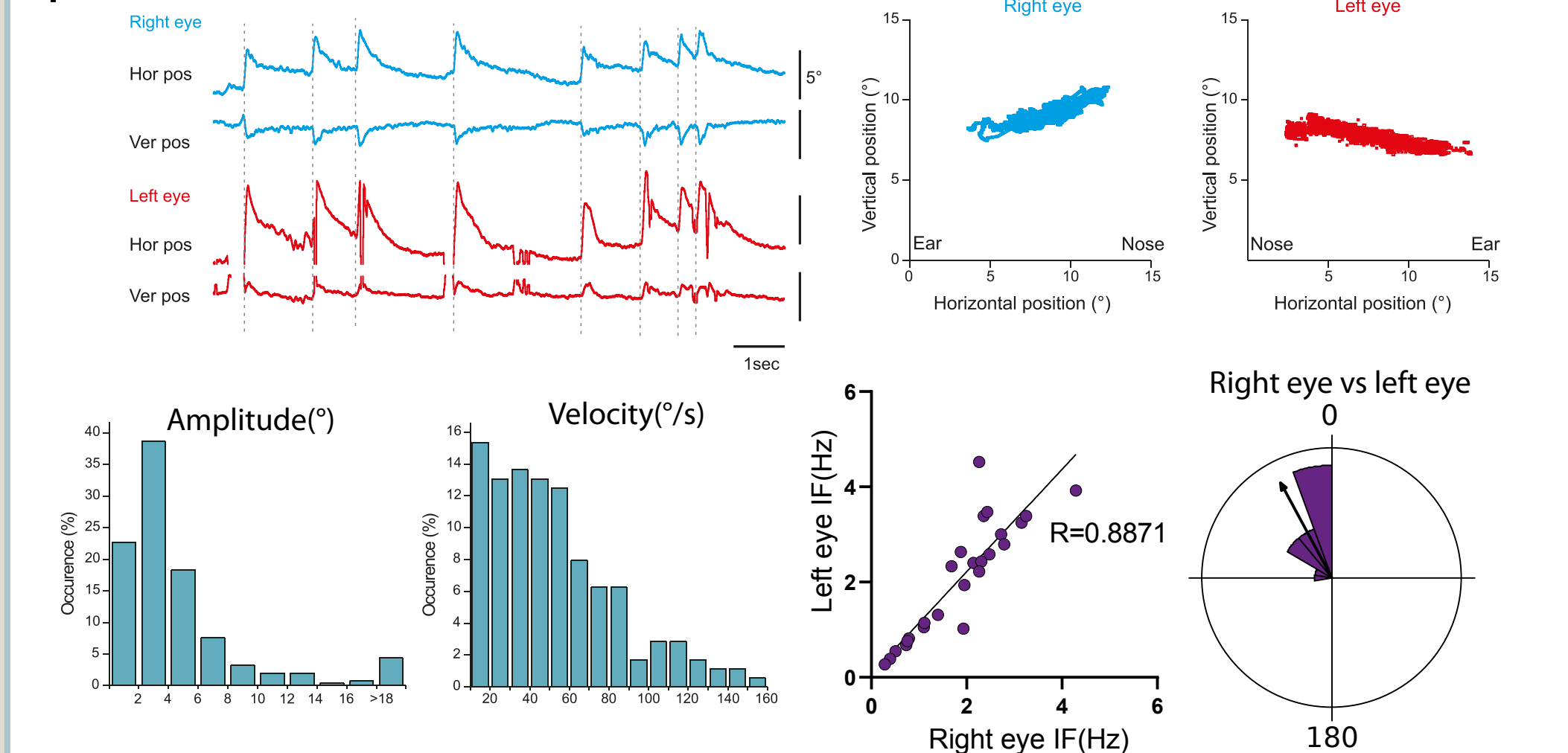
Eye movements during treadmill locomotion in precollicular premammillary decerebrated



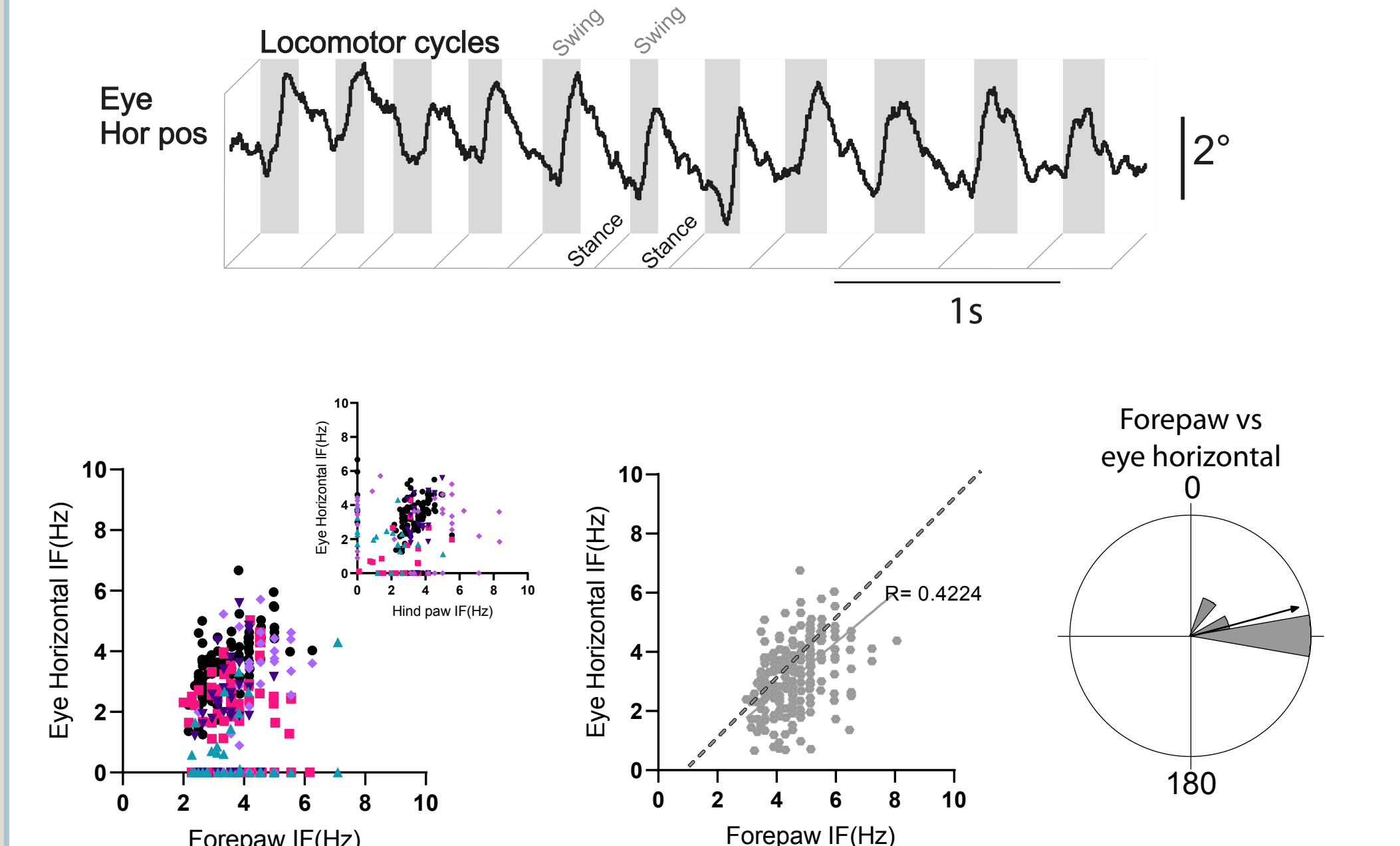
1. Locomotion: treadmill induced a trot-like pattern.



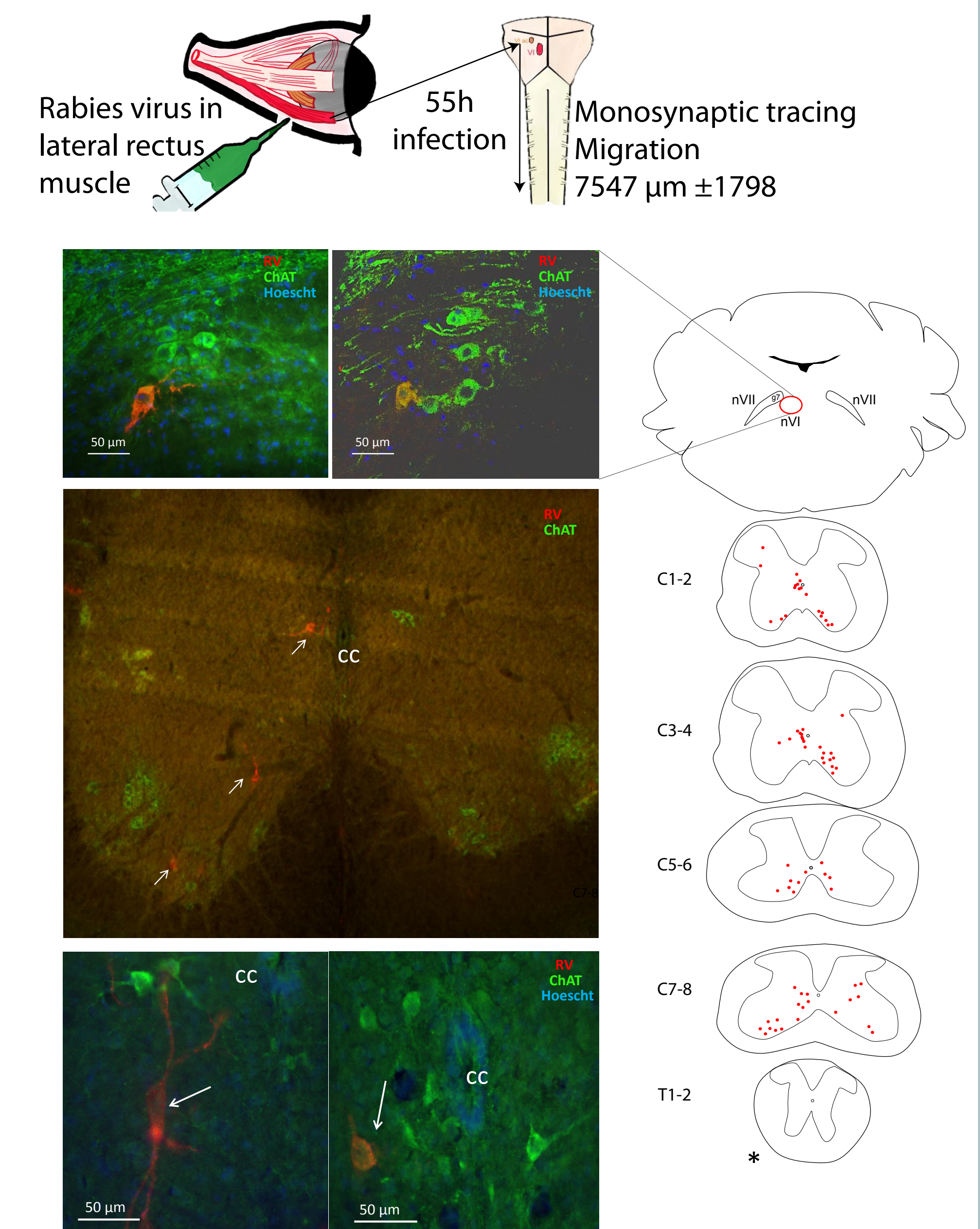
2. Eyes: conjugated eye movements are correlated and in phase



3. Coupling characteristics between limbs and eyes



Neuronal substrates of the spino-extraocular pathway

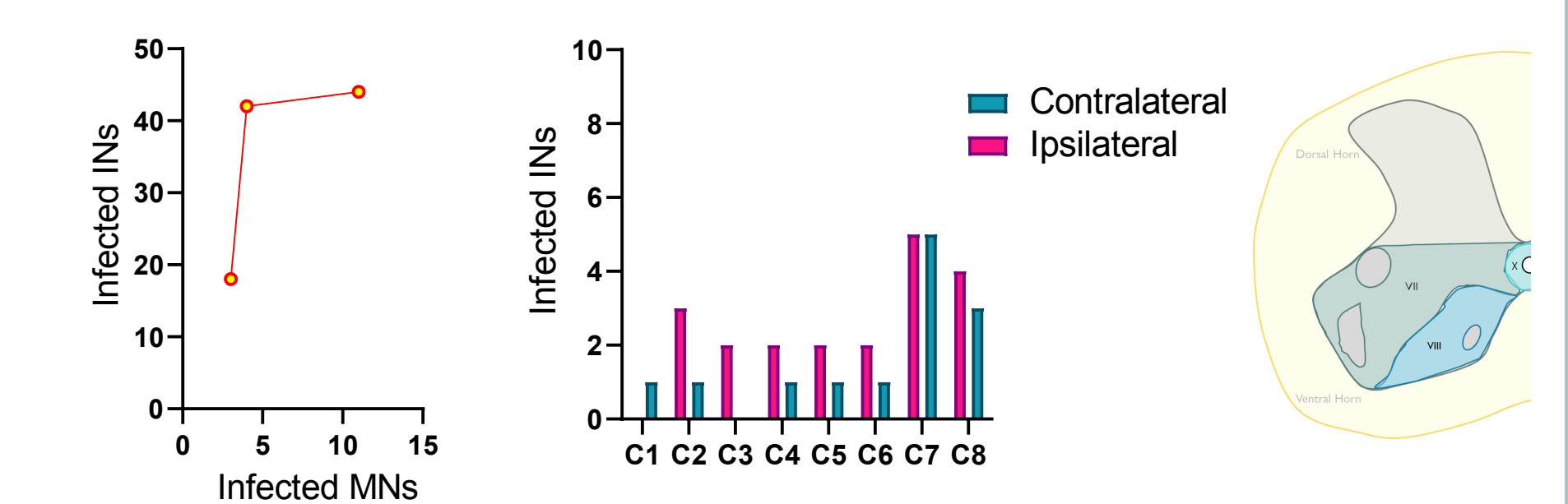


Injection of Rabies virus in the lateral rectus of adult mice: 1. Infected (RV+) motoneurons (ChAT labelling) in the abducens nucleus (nVI) ipsilateral to the injection.

2. RV+ interneurons are present all along the cervical (7547 μm ± 1798).

3. On average, 1 infected MN in the nVI affects 6 INs in the cervical.

4. C7 shows an homogeneous bilateral infection; C2-C6 and C8 infected mostly ipsilaterally (68%).



Acknowledgments

Work funded by the French entities: Agence Nationale de la Recherche (ANR) and the Centre National de la Recherche Scientifique (CNRS). We also thank Université de Paris and Bordeaux and the technical support provided by Patrice Jegouzo.

