

2012

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Alexander N. Klishko

David Cofer

Gennady Cymbalyuk


Georgia State University, [gcymbalyuk@gsu.edu](mailto:gcymbalyuk@gsu.edu)

Donald H. Edwards

Georgia State University, [dedwards@gsu.edu](mailto:dedwards@gsu.edu)

Boris I. Prilutsky

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## Recommended Citation

Klishko *et al.*: Paw-shake response and locomotion: Can one CPG generate two different rhythmic behaviors? *BMC Neuroscience* 2012 13(Suppl 1):P70. doi: 10.1186/1471-2202-13-S1-P70

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POSTER PRESENTATION

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# Paw-shake response and locomotion: can one CPG generate two different rhythmic behaviors?

Alexander N Klishko<sup>1\*</sup>, David Cofer<sup>2</sup>, Gennady Cymbalyuk<sup>2</sup>, Donald H Edwards<sup>2</sup>, Boris I Prilutsky<sup>1</sup>

From Twenty First Annual Computational Neuroscience Meeting: CNS\*2012  
Decatur, GA, USA. 21-26 July 2012

Rhythmic limb movements like locomotion or paw-shake response are controlled by network of spinal circuits, known as central pattern generators (CPGs), as evidenced from locomotor-like and paw-shake like activity in limb peripheral nerves elicited in decerebrate or spinal animals with blocked neuromuscular transmission [4]. Unlike fictive locomotion and scratch, that are likely controlled by distinct CPGs [3], fictive paw-shake response has not been systematically investigated and it is not known whether it is controlled by a specialized CPG or by the CPG that also controls locomotion. In-vivo recordings of paw-shake motor patterns elicited by stimulation of paw skin afferents [7] have revealed high frequency hindlimb oscillations (~10 Hz) with atypical muscle synergies – reciprocal activation of anterior and posterior hindlimb muscles in each half of the paw-shake cycle; both anterior and posterior muscle groups include flexor and extensor muscles. We asked whether a paw-shake response with the atypical muscle synergies can be generated by a typical half-center locomotor CPG reciprocally activating flexor and extensor muscles.

Using software AnimatLab [2] we developed a 5-segment cat hindlimb model with 12 Hill-type muscle actuators controlled by (1) a half-center CPG activating flexor and extensor muscles (two-joint muscles received both flexion- and extension-related signals [5,6]) and (2) proprioceptive input originated from the muscle spindle and Golgi tendon organ afferents. The CPG was modeled by two single-compartment spiking neurons in a half-center configuration. Other neurons (Ia-afferents, alpha-motor neurons, Ia-interneurons, and interneurons mediating autogenic and heterogenic reflex pathways) were modeled as non-spiking neurons (firing rate model based on work

by [1]). Model parameters were adjusted such that computer simulations reproduced the recorded paw-shake mechanics and the anterior-posterior muscle activation patterns.

The obtained results demonstrated that a half-center locomotor CPG can produce movement mechanics and muscle activity patterns typical for paw-shake responses if (1) the locomotor CPG is capable to operate at frequencies 3 to 10 times higher than during locomotion and (2) synaptic weights in spinal circuits can be modified during paw-shake response. We speculate that the two conditions can be realized by sensory input from paw skin afferents.

#### Acknowledgements

Supported by NIH grants: HD-032571, NS-048844, EB012855

#### Author details

<sup>1</sup>Center for Human Movement Studies, School of Applied Physiology, Georgia Institute of Technology, Atlanta, GA, USA. <sup>2</sup>Neuroscience Institute, Georgia State University, Atlanta, GA, USA.

Published: 16 July 2012

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\* Correspondence: [aklishko3@gatech.edu](mailto:aklishko3@gatech.edu)

<sup>1</sup>Center for Human Movement Studies, School of Applied Physiology, Georgia Institute of Technology, Atlanta, GA, USA

Full list of author information is available at the end of the article

doi:10.1186/1471-2202-13-S1-P70

**Cite this article as:** Klishko *et al.*: Paw-shake response and locomotion: can one CPG generate two different rhythmic behaviors? *BMC Neuroscience* 2012 **13**(Suppl 1):P70.

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