

# Disturbances in ENG rhythmic activity during fictive locomotion in the cat as clues to the modules of the spinal CPG.

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## 1 Introduction

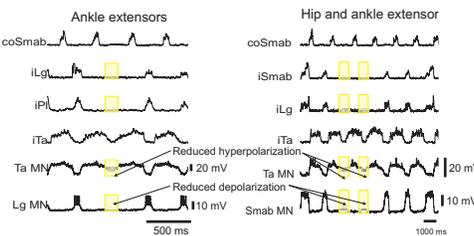
- Deletions are defined as missing bursts of activity in one or more electroneurograms while activity is maintained in others.
- During fictive locomotion in the cat, some step cycles show intermittent deletions of activity in some of the electroneurograms (Jordan, 1991).
- Deletions have also been observed in turtles during the scratch reflex (Robertson, 1988).
- Disturbances in a behavior such as locomotion give us clues as to how the behavior itself might be generated.

### Questions

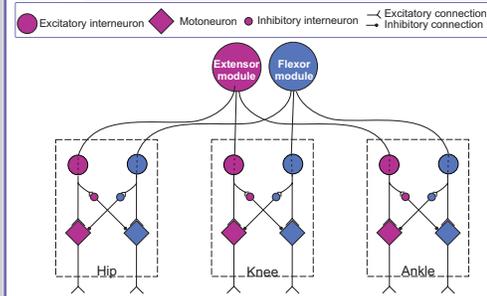
- What is the pattern of occurrence of deletions and what does it suggest regarding the organization of the spinal locomotor CPG?
- How is the locomotor drive potential altered during deletions and what does this suggest about the control of motoneurons by the locomotor CPG?

## 4 Deletion of excitation in extensors

- Deletions were observed in extensors at all hindlimb joints.
- During deletions, there was a decrease in the depolarization of synergist motoneurons.
- Concurrently, there was a decrease in the hyperpolarization of antagonist motoneurons.



## 7 Proposed organization of extensor and flexor modules

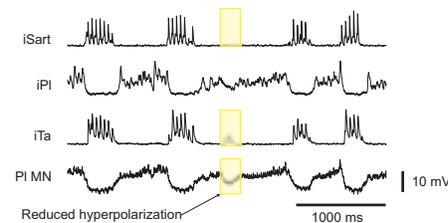


## 2 Methods

- Fictive locomotion was evoked in cats by electrical stimulation of the mesencephalic locomotor region.
- Recordings of hindlimb nerves (electroneurograms, ENGs), as well as intracellular recordings of lumbar motoneurons, were made during fictive locomotion.
- Electroneurograms from 5 animals and intracellular recordings from 10 pairs of motoneurons were analyzed.
- Motoneuron locomotor drive potentials (LDPs) were measured from intracellular recordings using the Analysis software (See Spinal Cord Research Center web site at <http://www.scr.c.umanitoba.ca/SCRC/factsheet.html>).

## 5 Deletion of excitation in flexors

- Deletions were observed in flexors of hindlimb joints as well.
- In this example, note the decrease in the hyperpolarization of an antagonist motoneuron.

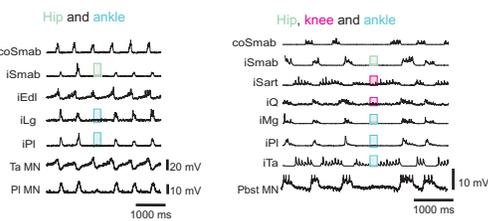


## 8 Conclusions

- Deletions occurred at all hindlimb joints and simultaneously at several of them. This suggests that the spinal locomotor CPG contains a module providing a coupled excitatory drive to agonists at all hindlimb joints. These results agree with correlational analysis of motoneuron pool activity which suggested that motor pools innervating muscles at hip, knee and ankle shared a common drive (Hamm, 1999).
- During deletions, not only is the depolarizing phase of the LDP of agonists reduced, but so is the hyperpolarizing phase of the LDP of antagonists. This suggests that there is excitatory coupling between the neurons producing the depolarization of agonists and the neurons producing the hyperpolarization of antagonists.

## 3 Deletions occur simultaneously at several hindlimb joints

- Deletions occurred simultaneously in nerves to several muscles of different hindlimb joints.
- We did not observe any deletion which occurred in nerves to muscles of a single joint only.



## 6 The spinal locomotor CPG has a modular organization

### What constitutes a module?

A module is defined by the following characteristics

1. It has a discrete motor output.
2. Its action is independent of other components.
  - It can function in the absence of activity in other components of the network.
  - It can be "deleted" from the network.
3. It is recruited during normal behavior.

## 9 References

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