Looking for the Decision Making Neurons in the Hindbrain of *Xenopus laevis* Tadpole.

Giulia Messa[1], Wenchang Li[2], Stella Koutsikou[1]
[1] University of Kent, Medway School fo Pharmacy, [2] University of St Andrews, School of Psychology and Neuroscience

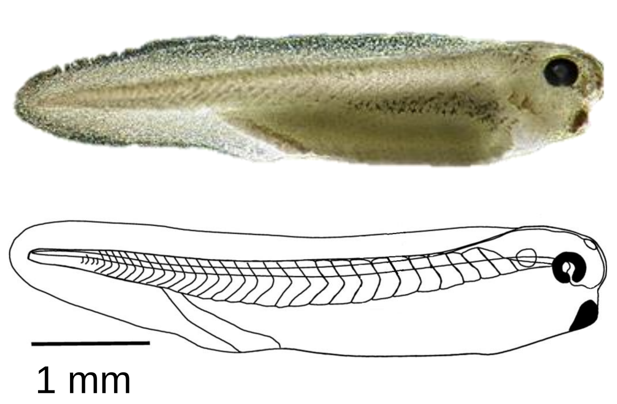
All animals, including humans, need to take decisions to ensure their well being and prosperity. For the hatchling tadpole, this occurs in **the choice between to swim or not to swim in response to a stimulus**. To achieve this binary decision, the tadpole needs to **1) detect external stimuli** through receptors in the skin, **2) transfer these information** to the brain where **3) it is integrated** and processed, until the "right" decision is made.

The sensory pathway which takes information from the periphery to the brain is well known: the **Rohon-Beard cells** are the first activated neurons, which make synaptic contact with the **DorsoLateral Commissural (DLC) cells**. From here sensory pathway neurons synapse with key Central Pattern Generator (CPG) neurons, the **reticulospinal Descending InterNeurons (dINs),** which will fire rhythmically once the swimming starts.

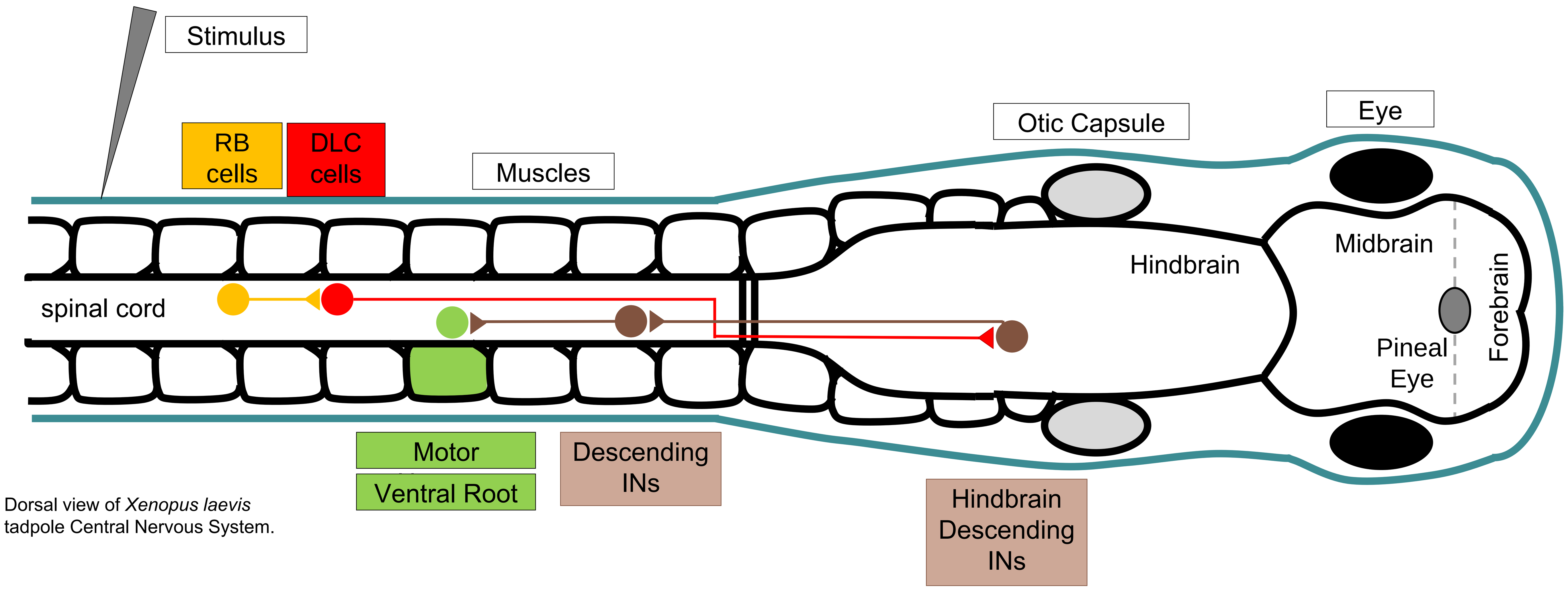
However the pathway leading to this simple decision, to swim or not to swim, is still incomplete. Firing in sensory pathway neurons is short latency (~6 ms) and too brief to explain the long delay to the initation of swimming (>35 ms).

Aim of the Study

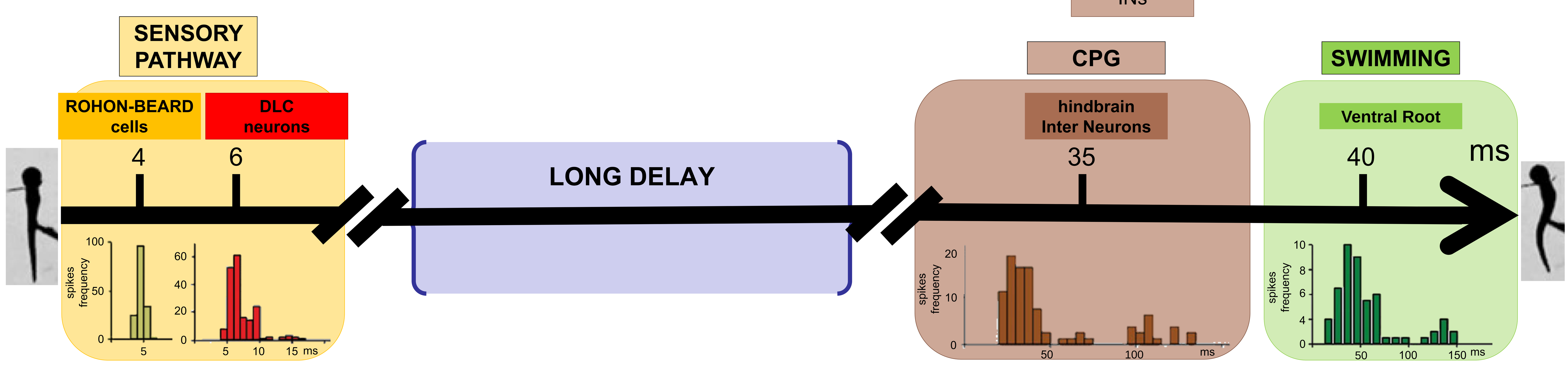
Characterize the cells and the mechanisms which account for the long delay between the sensory pathway activation and the firing of dINs.



Xenopus laevis tadpole at developmental stage 37-38



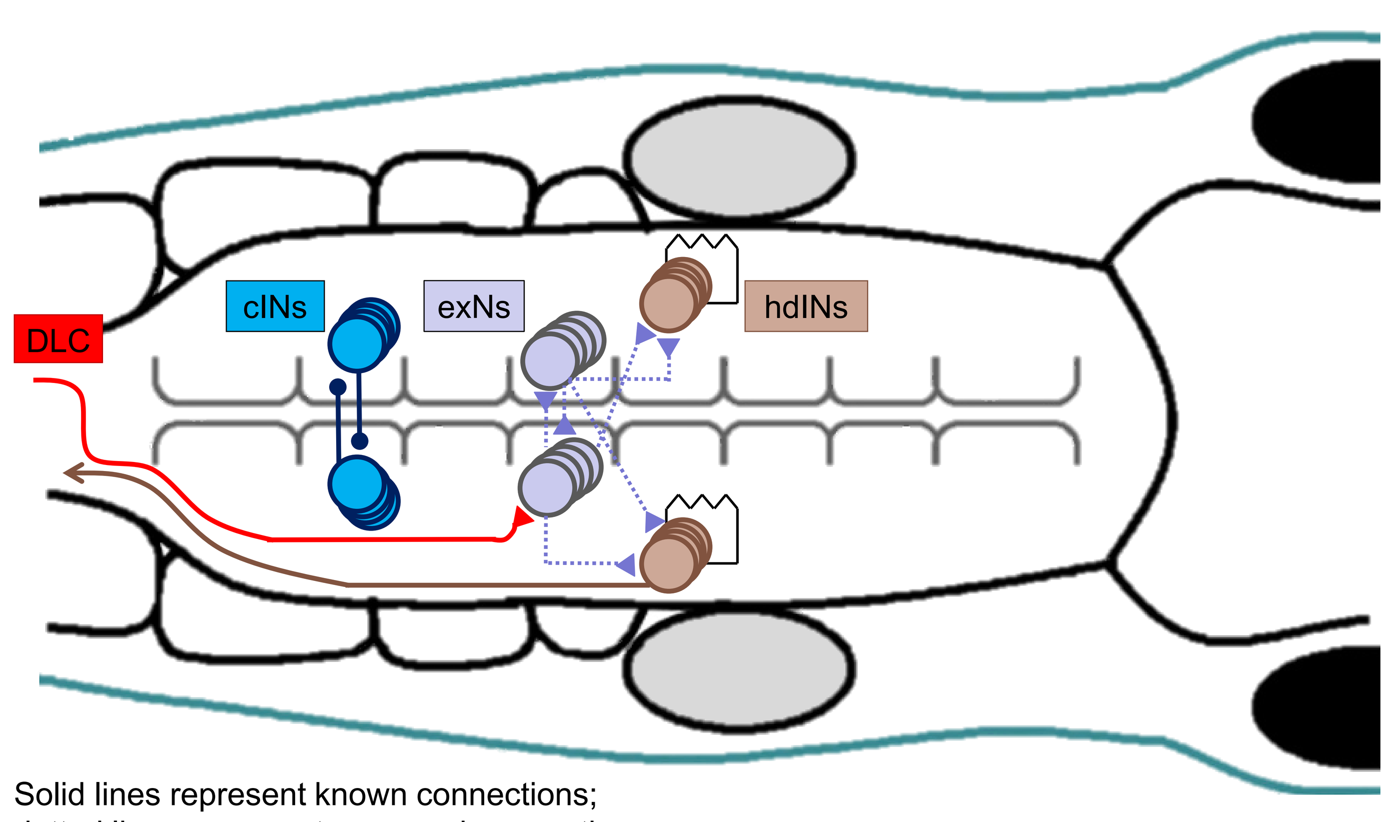
Dorsal view of *Xenopus laevis* tadpole Central Nervous System.



Histograms represent latencies of the first spike after a brief electrical stimulus given to the tail skin.

Hypothesis:

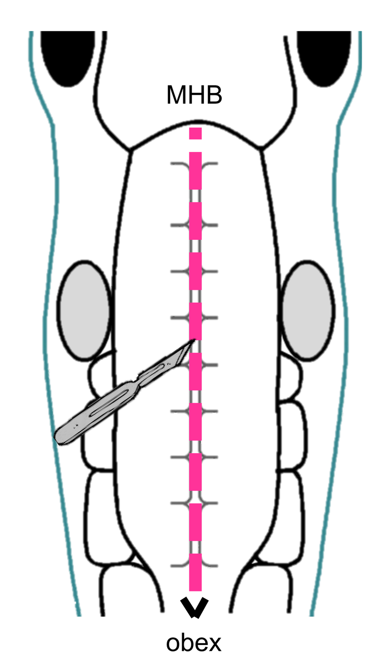
Extension Neurons integrate and process sensory information and deliver the decision to swim - or not - to the hbINs, connected to the dINs, which will then excite the motor neurons.



Solid lines represent known connections;
dotted lines represent proposed connections.

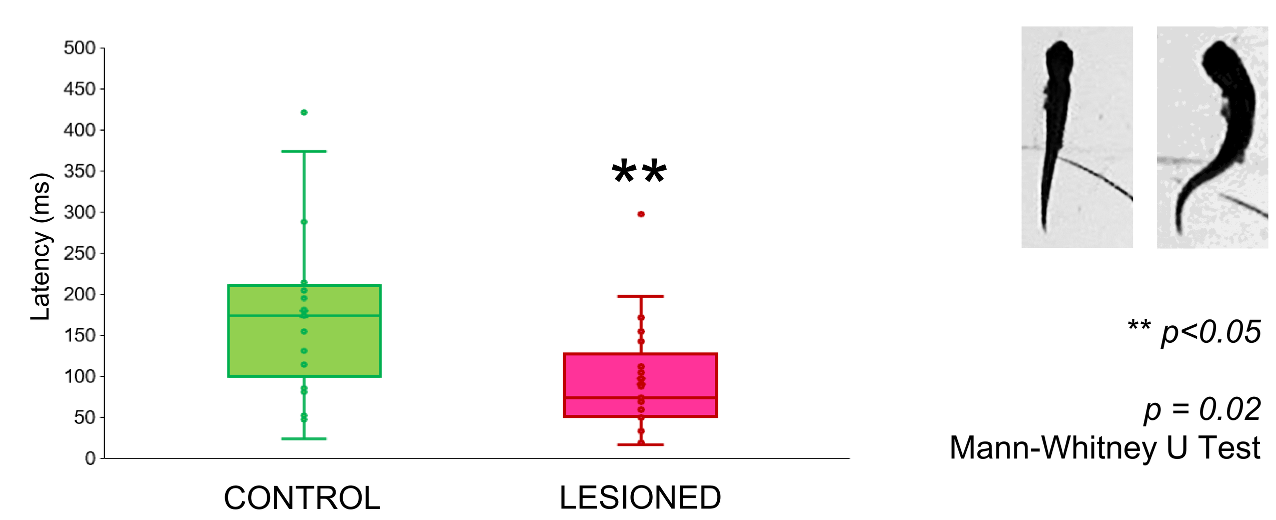
Hindbrain Midline Lesions:

Tadpoles at stage 37-38 were briefly anesthetized with MS-222 in saline. The two halves of the hindbrain were disconnected along the midline from the Midbrain-Hindbrain Border (MHB) to the obex, where the spinal cord begins.



Behavioural Analyses:

After recovery, tadpoles were put into a groove on Sylgard plate, with the fin upwards and the yolk belly accommodated into the groove. A brief stimulus was manually given with a hair to the tail skin. Slow motion videos were recorded at 420 fps, and the latency to the first bend was measured using ImageJ software.



There are commissural connections from exNs to either other exNs, or to dINs, which can account for the procrastination of the decision to swim.

Future Plans:

1. Behavioral Experiments:
- pinpoint the location of the exNs by doing smaller lesions along the hindbrain midline.

2. Electrophysiological Experiments:
- Map the exNs through extra cellular recording; ideally, recording simultaneously from the right and left side of the hindbrain.
- Once the exNs will be located, identify passive electrophysiological properties of exNs and their synaptic connections to the sensory pathway and to the dINs.

References:
- Koutsikou S. et al. (2018) *A simple decision to move in response to touch reveals basic sensory memory and mechanisms for variable response times.* J. Physiol. Aug 3.
- Roberts A, Li WC, Soffe SR (2010) *How neurons generate behavior in a hatchling amphibian tadpole: an outline.* Front Behav Neurosci. Jun 24;4:16.
- Li WC, Soffe S, Roberts A (2006) *Persistent responses to brief stimuli: feedback excitation among brainstem neurons.* J Neurosci. Apr 12;26(15):4026-35.

University of Kent
medway school of pharmacy