

Developmental Logic as Circuit Blueprint.

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The Giant Fiber Escape Response in *Drosophila*

A rapid, hardwired circuit mediates an innate escape jump in response to a looming threat.

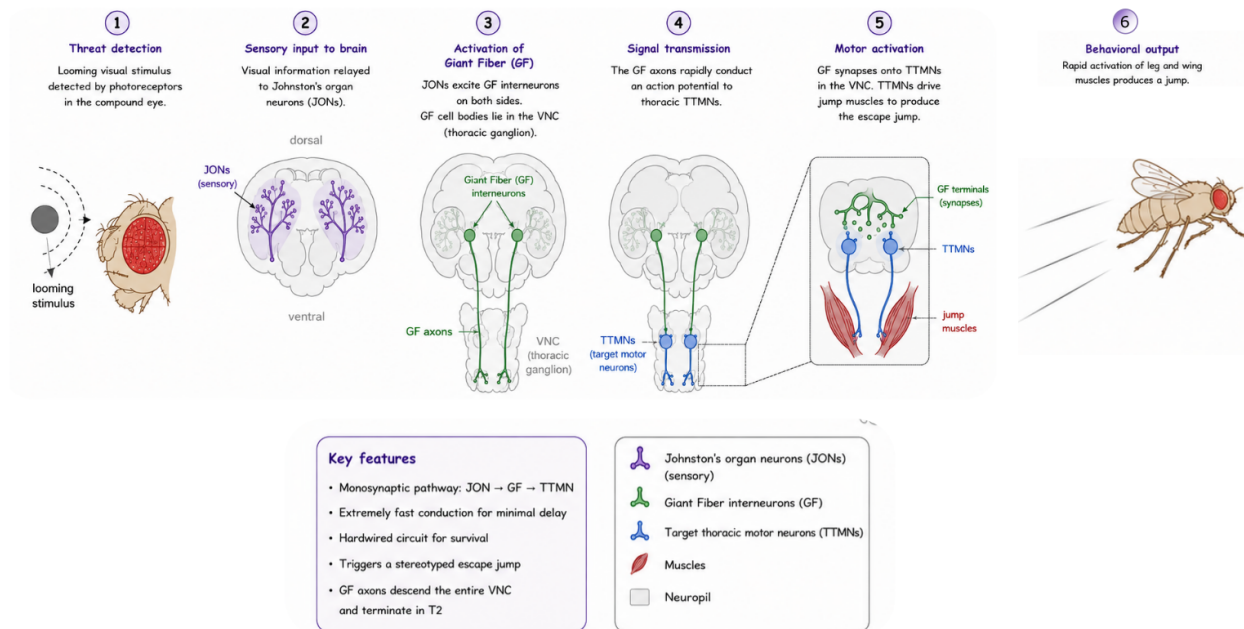


Figure 2: Cartoon of the *Drosophila* escape response.

Figure 1: Figure: Schematic of the giant fiber escape response in *Drosophila*. Bilateral giant fiber interneurons descend from the brain through the neck into the “spinal cord” (VNC) and terminate in the T2 neuropil, where they synapse onto tergotrochanteral motor neurons (TTMns) that drive jump muscle activation to jump away from danger.

0.1 Overview

This tutorial guides you through the Neuroglancer interface to examine the escape circuit.

First, you will visualize the key neurons of this survival response. The giant fiber neurons relay a danger signal from the brain where the threat is detected to the ventral nerve cord (the fly’s spinal cord). This activates the motor neurons that trigger the jump movement so that the fly moves away from the danger. These motorneurons are called the tergotrochanteral motor neurons

(TTMn’s), after the tergotrochanter muscle they innervate, which is a leg extensor muscle.

Follow this link to look at the brain, and see the location of the cell bodies of the giant fiber neurons.

Next, you will investigate how neurons populations derived from different stem cells interact with these same motor neurons contribute. In essence, you are tracing the premotor control of the tergotrochanteral motor neuron (TTMn). We call these neurons presynaptic partners.



Figure 3: click to open NeuPrint link or scan the QR code.

0.2 Overview of Dataset (for reference)

Presynaptic partners of the TTMn were identified from the MANC connectome v1.2 using a neuPrint query that extracts upstream neurons forming ≥ 10 synapses onto the TTMn. Neurons not assigned to a hemilineage were excluded from analysis. The resulting dataset is provided in Table 1, which includes neuron IDs, hemilineage identity, synapse counts, and neurotransmitter annotations.

This link directs you to a viewer screen, which has a few items preloaded:

- The full EM volume as a structural reference;
 - Neuropil outlines for anatomical context;
 - The Giant Fiber (from the neck into the ventral nerve cord, the central brain is chopped off);
 - The jump muscle motor neuron (TTMn);
 - Neurons from specific neuronal populations (hemilineages) that synapse with the TTMn (AKA: TTMn premotor input);
 - The complete hemilineage as reference (for thoracic segment 2).
- **TTMn** (motor neuron; typically highlighted in orange)
 - **GF neuron** (command neuron; typically highlighted in blue)
 - **Neuropil boundaries**, focusing on the T2 neuromere
 - **Premotor input neurons** (loaded from the query dataset)
 - **Hemilineage reference neurons** (to evaluate the proportion of a hemilineage that synapses to the TTMn)

3. Adjust visualization settings:

- Left window, eye icon: Toggle layers on/off to isolate specific neuron populations (see Figure 5b, Figure 5c).
- Right window, Use transparency controls to visualize spatial overlap (see Figure 5d)
- Rotate to a **dorsal view** for consistency with Figure 3

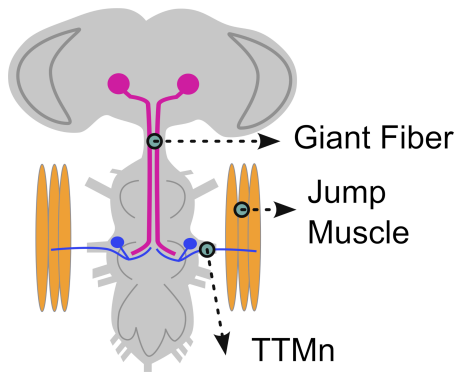
0.3.2 B. Identifying Premotor Inputs

4. Select individual hemilineage neurons from the dataset layer.
5. Trace their projections relative to:
 - The TTMn dendritic field
 - The GF axon
6. Use view toggles to:
 - Highlight synaptic contacts onto the TTMn

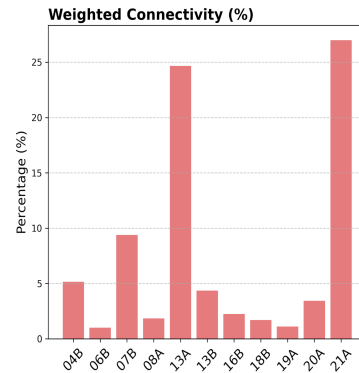
0.3 Classroom Execution

0.3.1 A. Orientation in Neuroglancer

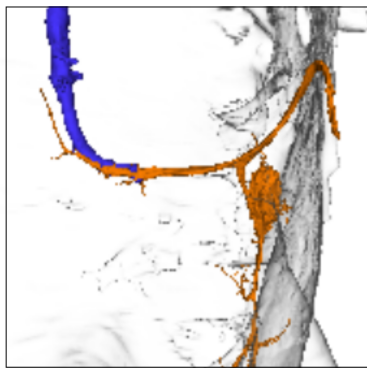
1. Open the Neuroglancer link (see Figure 5a).
2. Identify the following elements: Left panel 1



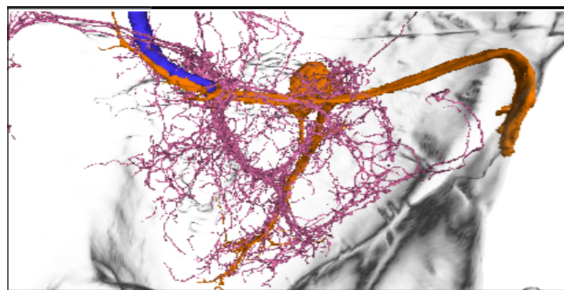
(a) cartoon of the escape circuit



(b) weighed connectivity graph per hemilineage



(c) 3D screenshot of giant fiber- TTMn interface



(d) 3D screenshot with hemilineage07B added

Figure 4: Giant Fiber

- Compare morphology across neurons from different hemilineages

0.3.3 C. Guided Analysis (connect to main text questions)

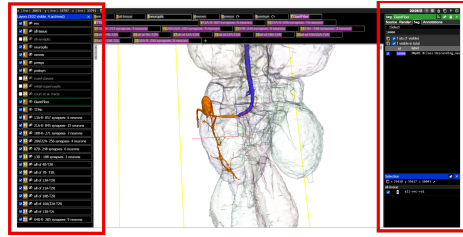
Using the Neuroglancer view and dataset, address the following:

- Which hemilineages provide the strongest synaptic input to the TTMn?
- Does hemilineage 7B form direct synaptic contacts with the TTMn? Where are these located?
- Do neurons from the same hemilineage show similar or diverse morphologies?
- How are inputs spatially organized relative to the TTMn dendrites?
- Based on neurotransmitter identity, which hemilineages are likely excitatory vs. inhibitory? Tip:
 - Acetylcholine (ACh) → excitatory
 - Glutamate (Glu) → often excitatory
 - GABA → inhibitory?

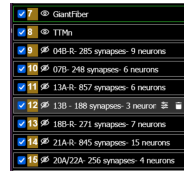
- How might these chemical inputs interact with the fast electrical GF→TTMn pathway?

0.3.4 D. Linking Structure to Hemilineage Identity (Advanced)

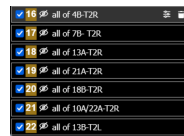
7. Cross-reference selected neurons with Table 1:
 - Identify their hemilineage assignment
 - Note synapse counts onto TTMn
 - Record neurotransmitter identity
8. For each hemilineage:
 - Determine how many neurons contribute input to the TTMn
 - Estimate their relative contribution to total TTMn input



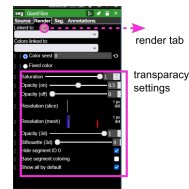
(a) Layer control



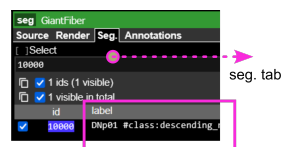
(b)



(c)



(d) Render tab



(e) Segmentation tab

Figure 5: Neuroglancer

0.4 Hemilineage

Table 1: Hemilineage

Hemi-lineage	Row Labels	Sum of c.weight
17A	11404	10
08A	22549	12
	169711	10
00A	16388	15
	17047	12
12B	29239	33
06B	10812	18
	11682	18
16B	14424	59
(blank)	10000	146
	10634	13
	24797	10
	225692	12
13B	11111	161
	35435	17
	156615	10
07B	14155	59
	16174	34
	16544	45
	18516	23
	20588	47
	101550	40
20A.22A	11530	86
	11877	102
	13081	58
	16156	10
04B	15036	58
	16171	13
	16530	23
	16640	31
	16772	26
	19473	35

Hemi- lineage	Row Labels	Sum of c.weight
18B	21464	14
	22299	21
	101891	37
	13645	26
	13846	156
	14882	22
	17245	21
	17824	10
	18131	14
	21171	22
21A	15336	75
	16186	97
	16427	12
	17013	139
	17073	167
	17558	30
	18306	11
	20731	59
	20905	64
	24383	13
	27296	23
	28678	11
	36932	21
	101974	28
	152381	95
13A	14366	256
	15024	178
	16681	90
	17350	183
	27506	14
	33275	136
Grand Total		3291