
Context-Gated and Electrical Synapse-Mediated Brain-Wide Activity Reorganization Regulates Learning Behavior in *C. elegans*

Jingting Liang^{1, 2, #}, Sihoon Moon^{3, #}, Sahil Moza^{1, 2, #}, Hyun Jee Lee^{3, #}, Panagiotis E. Eleftheriadis^{1, 2}, Juan Chen^{1, 2}, Minghai Ge^{1, 2}, Maoting Chen^{1, 2}, Hang Lu^{3, *}, Yun Zhang^{1, 2, *}

1 Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA 02138, USA.

2 Center for Brain Science, Harvard University, Cambridge, MA 02138, USA.

3 School of Chemical & Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA.

Co-first authors

* Correspondence: hang.lu@gatech.edu, yzhang@oeb.harvard.edu

1 **Online Resource Fig. 1 (associated with Extended Data Fig. 3, 4): Contrast odorants**
2 **evoke neural responses in different contexts. a-c**, Violin plots showing kernel densities of the
3 distribution of medians for neurons in response to the contrast odorants (Buffer or PA14-*gacA*(-))
4 in different contexts in naive (gray) and trained (purple) animals. **a**, Buffer-Buffer-Buffer. **b**,
5 OP50-Buffer-OP50. **c**, OP50-PA14-*gacA*(-)-OP50.

6 **Online Resource Fig. 2 (associated with Extended Data Fig. 3, 4): PA14 evokes neural**
7 **responses in the *inx-7* mutant strain and the *inx-7* rescue strain. a-c**, Violin plots showing
8 kernel densities of the distribution of medians for the sensory-inter group I neurons in response to
9 the PA14 contrast odorants in naive (gray) and trained (purple) animals in the *inx-7*-mutant strain
10 (**a**) and the *inx-7*-rescue strain (**b**).

11 **Online Resource Fig. 3 (associated with Fig. 5 and Extended Data Fig. 10): Loadings**
12 **for neural components, NC1, NC2, NC3, for sensory-inter-motor group I, sensory-inter-**
13 **motor group II, sensory-inter-motor group III, inter-motor group, sensory-inter group**
14 **II, sensory-inter group III. Colors represent loading amplitudes.**

15 **Online Resource Fig. 4 (associated with Fig. 5 and Extended Data Fig. 10): Average**
16 **input scaling (*B*) matrices for the detection task (Buffer-PA14-Buffer stimulation**
17 **pattern) for different neuron groups and training conditions. sensory-inter-motor group**
18 **I, sensory-inter-motor group III, inter-motor group, sensory-inter group II, sensory-inter group III,**
19 **sensory-inter-motor group II. Colors represent amplitudes.**

20 **Online Resource Fig. 5 (associated with Fig. 5 and Extended Data Fig. 10): Average**
21 **input scaling (*B*) matrices for OP50-Buffer-OP50 (left) and OP50-PA14-*gacA*(-)-OP50**
22 **(right) referred as OP50-*gacA*-OP50 for the sensory-inter group I neurons. Colors**
23 **represent amplitudes.**

24 **Online Resource Fig. 6 (associated with Fig. 5 and Extended Data Fig. 10): Average**
25 **input scaling (*B*) matrices for the discrimination task (OP50-PA14-OP50 stimulation**
26 **pattern) for different neuron groups and training conditions. sensory-inter-motor group**
27 **I, sensory-inter-motor group III, inter-motor group, sensory-inter group II, sensory-inter group III,**
28 **sensory-inter-motor group II. Colors represent amplitudes.**

29 **Online Resource Fig. 7 (associated with Fig. 5 and Extended Data Fig. 10): Average**
30 **input scaling (B) matrices for Buffer-Buffer-Buffer stimulation pattern for different**
31 **neuron groups and training conditions.** sensory-inter-motor group I, inter-motor group,
32 sensory-inter-motor group II, sensory-inter group I, sensory-inter group III. Colors represent loading
33 amplitudes.