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Supplementary Material: Synchronization patterns in modular neuronal networks: a case study of *C. elegans*

1 LEVEL OF SYNCHRONIZATION

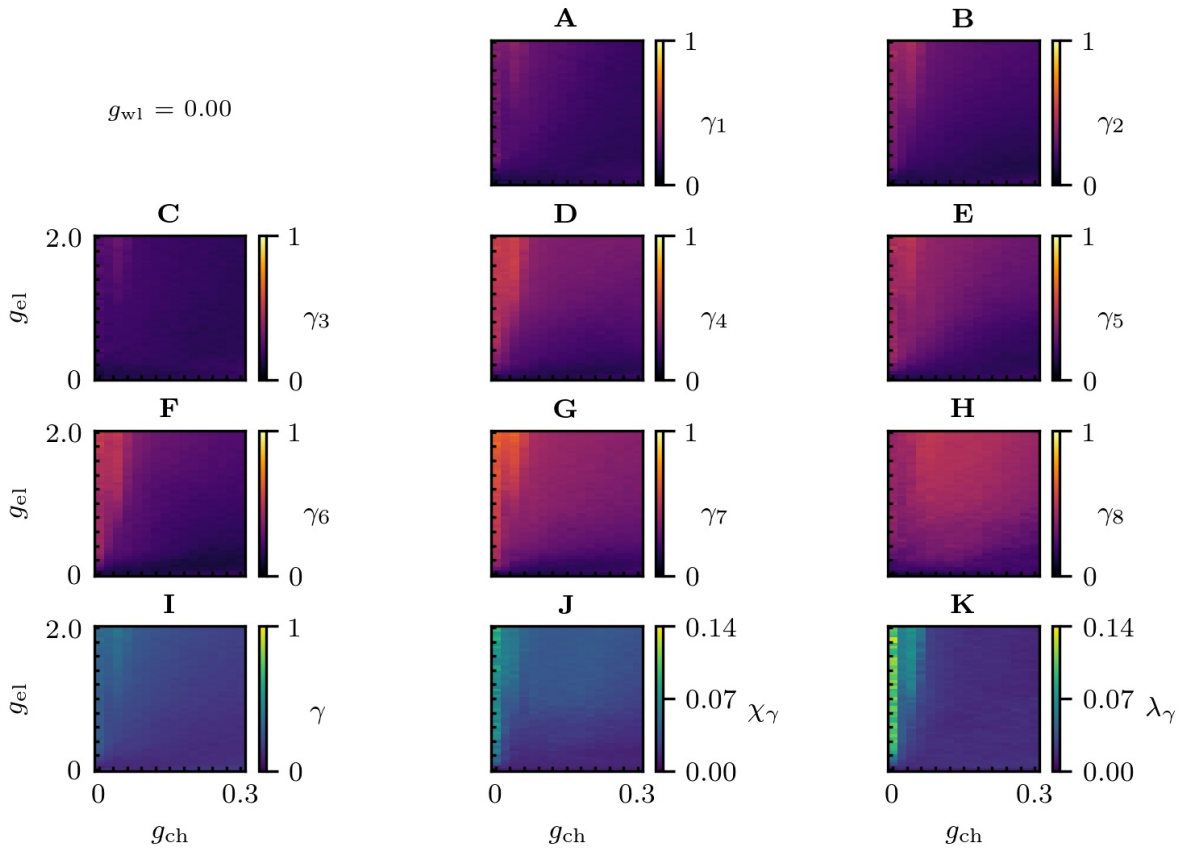

Figure S1. Synchronization parameter scans of the Multilayer-Louvain network. Absence of wireless coupling ($g_{wl} = 0$) for different electrical and chemical couplings: **(A)** - **(H)** the level of synchronization for all communities γ_1 - γ_6, **(I)** - **(K)** the global level of synchronization of the whole network γ, the chimera-like index χ_γ and the metastability index λ_γ. The system parameters are the same as in **figure 6 (A), (B), (C)**

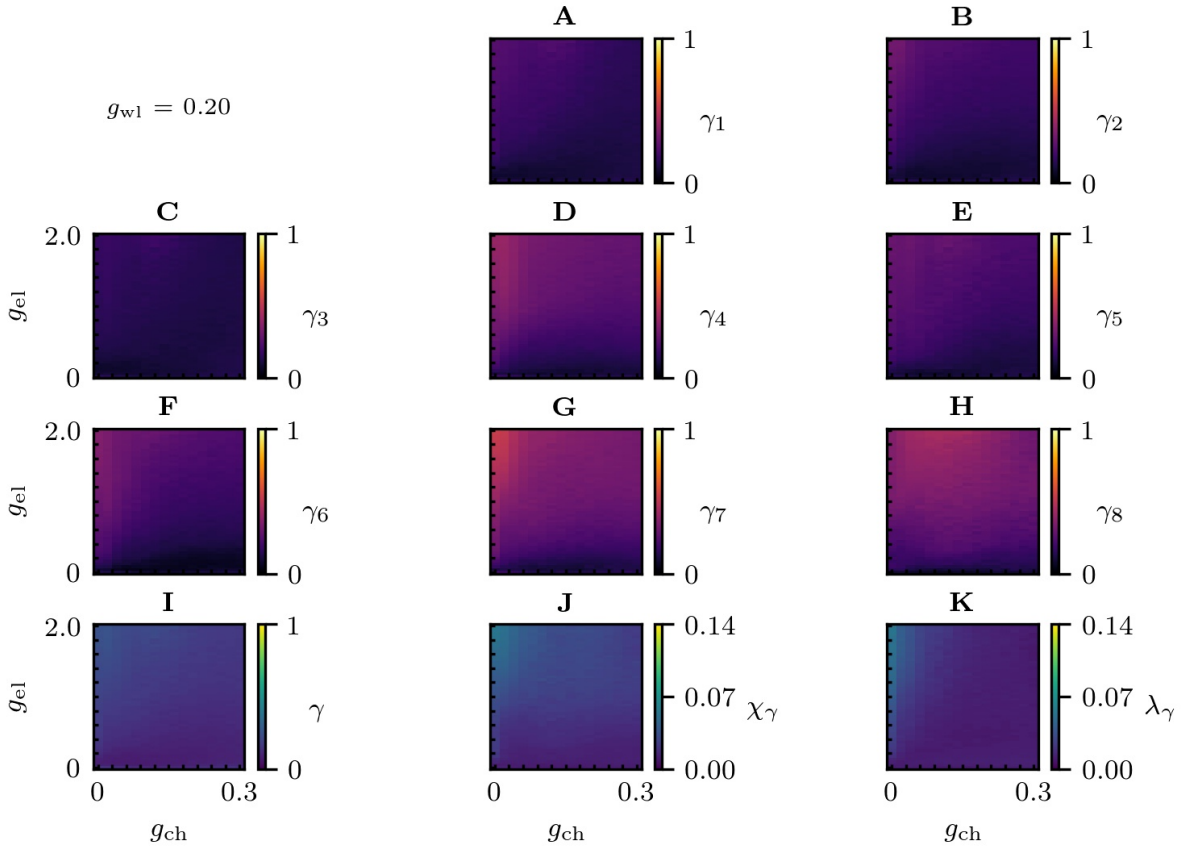

Figure S2. Synchronization parameter scans of the Multilayer-Louvain network. Presence of wireless coupling ($g_{\mathrm{wl}} = 0.20$) for different electrical and chemical couplings: **(A)** - **(H)** the level of synchronization for all communities γ_1 - γ_6, **(I)** - **(K)** the global level of synchronization of the whole network γ, the chimera-like index χ_γ and the metastability index λ_γ. The system parameters are the same as in **figure 6 (D), (E), (F)**

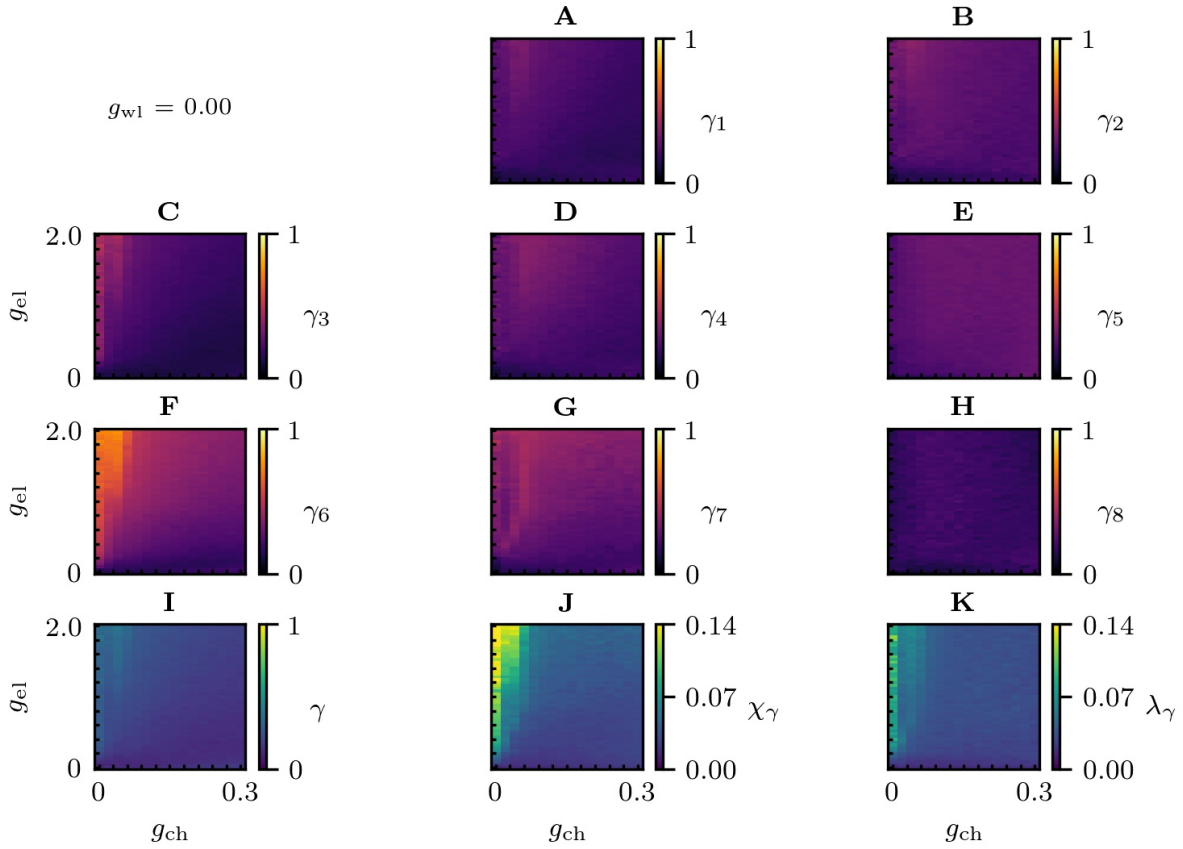

Figure S3. Synchronization parameter scans of the dynamical correlation-based network. Absence of wireless coupling ($g_{\mathrm{wl}} = 0$) for different electrical and chemical couplings: **(A)** - **(H)** the level of synchronization for all communities γ_1 - γ_6, **(I)** - **(K)** the global level of synchronization of the whole network γ, the chimera-like index χ_γ and the metastability index λ_γ. The system parameters are the same as in **figure 9 (A), (B), (C)**

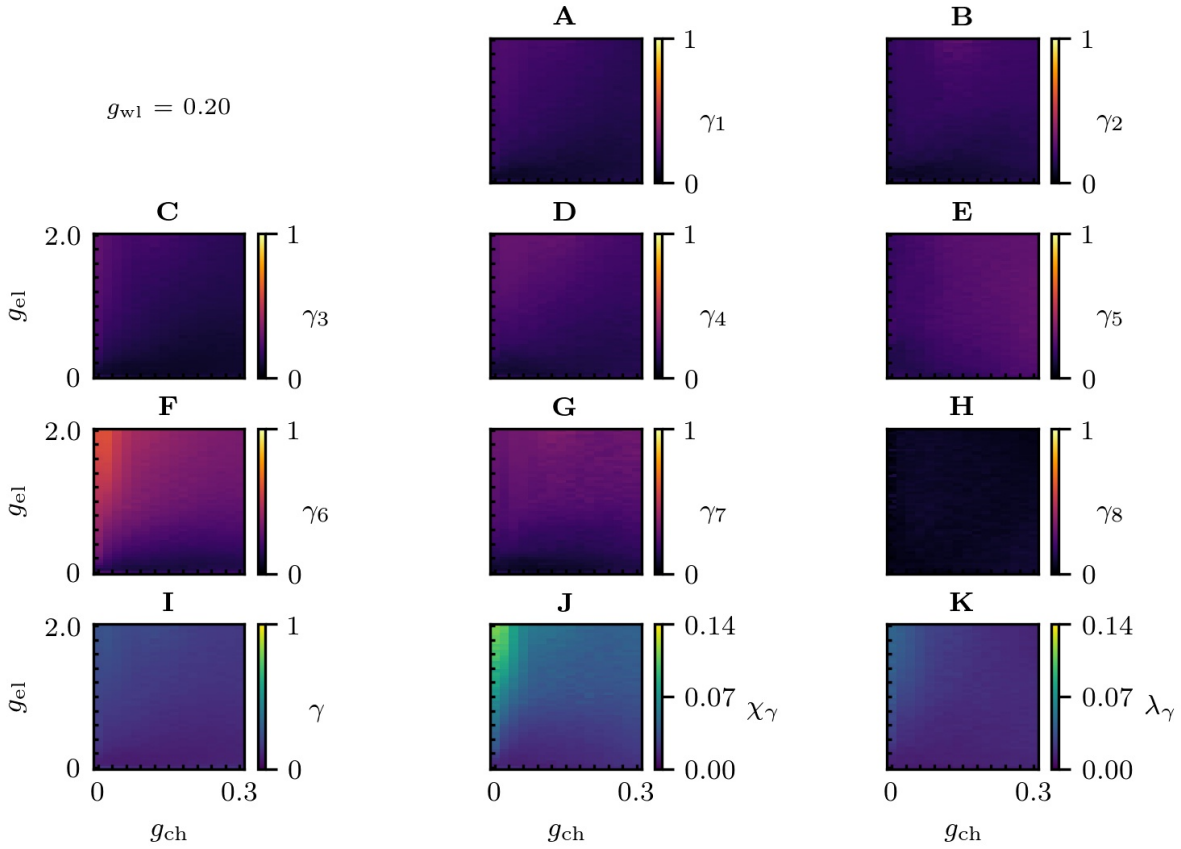

Figure S4. Synchronization parameter scans of the dynamical correlation-based network. Presence of wireless coupling ($g_{\mathrm{wl}} = 0.20$) for different electrical and chemical couplings: **(A)** - **(H)** the level of synchronization for all communities γ_1 - γ_6, **(I)** - **(K)** the global level of synchronization of the whole network γ, the chimera-like index χ_γ and the metastability index λ_γ. The system parameters are the same as in **figure 9 (D), (E), (F)**

2 NEURON NAMES AND THEIR CHARACTERISTICS

Table S1: Neuron names and their characteristics. EN: Electrical Neuron. CS: Chemical Source. CT: Chemical Target. WS: Wireless Source. WT: Wireless Target. PMLC: Partition "Multilayer-Louvain" Community. PDCBC: Partition "dynamical correlation-based" Community.

	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
0	ADAL	Interneuron	1	1	1	0	0	6	1
1	ADAR	Interneuron	1	1	1	0	0	1	1
2	ADEL	Sensory	1	1	1	1	1	2	2
3	ADER	Sensory	1	1	1	1	1	2	3
4	ADFL	Sensory	1	1	1	1	0	1	2
5	ADFR	Sensory	1	1	1	1	0	1	4
6	ADLL	Sensory	1	1	1	0	1	3	1
7	ADLR	Sensory	1	1	1	0	1	3	4
8	AFDL	Sensory	1	1	1	0	1	3	3
9	AFDR	Sensory	1	1	1	0	1	3	3
10	AIAL	Interneuron	1	1	1	0	1	3	2
11	AIAR	Interneuron	1	1	1	0	1	3	2
12	AIBL	Interneuron	1	1	1	0	1	3	3
13	AIBR	Interneuron	1	1	1	0	1	3	3
14	AIML	Interneuron	1	1	1	0	1	8	1
15	AIMR	Interneuron	0	1	1	0	1	3	5
16	AINL	Interneuron	1	1	0	0	0	3	2
17	AINR	Interneuron	1	1	1	0	0	3	2
18	AIYL	Interneuron	1	1	1	0	1	3	1
19	AIYR	Interneuron	1	1	1	0	1	3	3
20	AIZL	Interneuron	1	1	1	0	1	3	4
21	AIZR	Interneuron	1	1	1	0	1	3	4
22	ALA	Interneuron	1	1	1	0	0	6	3
23	ALML	Sensory	1	1	1	0	1	1	3
24	ALMR	Sensory	1	1	1	0	1	2	1
25	ALNL	Sensory	1	1	1	0	1	5	3
26	ALNR	Sensory	0	1	1	0	1	2	5
27	AQR	Sensory	1	1	1	0	0	5	3
28	AS01	Motor	1	1	1	0	1	7	6
29	AS02	Motor	1	1	1	0	1	7	6
30	AS03	Motor	1	1	1	0	1	4	6
31	AS04	Motor	1	1	1	0	1	4	7
32	AS05	Motor	1	1	1	0	1	4	6
33	AS06	Motor	1	1	1	0	1	4	6
34	AS07	Motor	1	0	1	0	1	2	6

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Table S1: Neuron names and their characteristics. EN: Electrical Neuron. CS: Chemical Source. CT: Chemical Target. WS: Wireless Source. WT: Wireless Target. PMLC: Partition "Multilayer-Louvain" Community. PDCBC: Partition "dynamical correlation-based" Community.

	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
35	AS08	Motor	1	0	1	0	1	2	6
36	AS09	Motor	1	1	1	0	1	2	6
37	AS10	Motor	1	0	1	0	1	2	6
38	AS11	Motor	1	1	1	0	1	2	7
39	ASEL	Sensory	0	1	1	0	1	3	8
40	ASER	Sensory	0	1	1	0	1	3	8
41	ASGL	Sensory	1	1	1	0	1	3	2
42	ASGR	Sensory	1	1	1	0	1	3	2
43	ASHL	Sensory	1	1	1	0	1	3	4
44	ASHR	Sensory	1	1	1	0	1	1	4
45	ASIL	Sensory	1	1	0	0	1	3	2
46	ASIR	Sensory	1	1	0	0	1	3	2
47	ASJL	Sensory	1	1	1	0	0	3	5
48	ASJR	Sensory	1	1	1	0	0	3	5
49	ASKL	Sensory	1	1	1	0	1	3	4
50	ASKR	Sensory	1	1	1	0	1	3	4
51	AUAL	Sensory	1	1	1	0	1	1	2
52	AUAR	Sensory	1	1	1	0	1	1	2
53	AVAL	Interneuron	1	1	1	0	0	2	6
54	AVAR	Interneuron	1	1	1	0	0	2	6
55	AVBL	Interneuron	1	1	1	0	1	6	6
56	AVBR	Interneuron	1	1	1	0	1	6	6
57	AVDL	Interneuron	1	1	1	0	0	2	3
58	AVDR	Interneuron	1	1	1	0	0	2	3
59	AVEL	Interneuron	1	1	1	0	0	1	3
60	AVER	Interneuron	1	1	1	0	0	1	3
61	AVFL	Interneuron	1	1	1	0	1	8	4
62	AVFR	Interneuron	1	1	1	0	1	8	4
63	AVG	Interneuron	1	1	1	0	0	8	1
64	AVHL	Interneuron	1	1	1	0	1	8	4
65	AVHR	Interneuron	1	1	1	0	1	8	4
66	AVJL	Interneuron	1	1	1	0	1	2	6
67	AVJR	Interneuron	1	1	1	0	1	2	6
68	AVKL	Interneuron	1	1	1	0	0	5	3
69	AVKR	Interneuron	1	1	1	0	0	5	3
70	AVL	Motor	1	1	1	0	1	5	3
71	AVM	Sensory	1	1	1	0	1	6	3

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Table S1: Neuron names and their characteristics. EN: Electrical Neuron. CS: Chemical Source. CT: Chemical Target. WS: Wireless Source. WT: Wireless Target. PMLC: Partition "Multilayer-Louvain" Community. PDCBC: Partition "dynamical correlation-based" Community.

	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
72	AWAL	Sensory	1	1	1	0	0	3	2
73	AWAR	Sensory	1	1	1	0	0	3	2
74	AWBL	Sensory	1	1	1	0	1	1	2
75	AWBR	Sensory	1	1	1	0	1	1	4
76	AWCL	Sensory	0	1	1	0	1	3	8
77	AWCR	Sensory	0	1	1	0	1	3	8
78	BAGL	Sensory	1	1	1	0	1	1	3
79	BAGR	Sensory	1	1	1	0	1	1	3
80	BDUL	Interneuron	0	1	1	0	1	2	2
81	BDUR	Interneuron	0	1	1	0	1	2	2
82	CEPDL	Sensory	1	1	1	1	1	1	3
83	CEPDR	Sensory	1	1	1	1	1	1	3
84	CEPVL	Sensory	1	1	1	1	1	1	3
85	CEPVR	Sensory	1	1	1	1	1	1	3
86	DA01	Motor	1	1	1	0	1	7	6
87	DA02	Motor	1	1	1	0	1	7	6
88	DA03	Motor	1	1	1	0	1	4	6
89	DA04	Motor	1	1	1	0	1	4	6
90	DA05	Motor	1	1	1	0	1	4	6
91	DA06	Motor	1	1	1	0	1	2	6
92	DA07	Motor	1	0	1	0	1	2	6
93	DA08	Motor	1	0	1	0	1	2	6
94	DA09	Motor	1	1	1	0	1	2	6
95	DB01	Motor	1	1	1	0	1	7	6
96	DB02	Motor	1	1	1	0	1	4	6
97	DB03	Motor	1	1	1	0	1	4	6
98	DB04	Motor	1	1	1	0	1	4	6
99	DB05	Motor	1	0	1	0	1	2	6
100	DB06	Motor	1	0	1	0	1	2	6
101	DB07	Motor	1	1	1	0	1	2	6
102	DD01	Motor	1	1	1	0	1	7	3
103	DD02	Motor	1	1	1	0	1	4	3
104	DD03	Motor	1	0	1	0	1	4	3
105	DD04	Motor	1	0	1	0	1	4	3
106	DD05	Motor	1	1	1	0	1	6	3
107	DD06	Motor	0	0	1	0	1	2	1
108	DVA	Interneuron	1	1	1	0	1	5	6

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Table S1: Neuron names and their characteristics. EN: Electrical Neuron. CS: Chemical Source. CT: Chemical Target. WS: Wireless Source. WT: Wireless Target. PMLC: Partition "Multilayer-Louvain" Community. PDCBC: Partition "dynamical correlation-based" Community.

	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
109	DVB	Motor	1	1	0	0	0	2	6
110	DVC	Interneuron	1	1	1	0	1	5	3
111	FLPL	Sensory	1	1	1	0	1	2	3
112	FLPR	Sensory	1	1	1	0	1	2	3
113	HSNL	Motor	1	1	1	1	1	3	2
114	HSNR	Motor	1	1	1	1	1	3	2
115	IL1DL	Sensory	1	1	1	0	1	1	1
116	IL1DR	Sensory	1	1	1	0	1	1	1
117	IL1L	Sensory	1	1	1	0	1	1	4
118	IL1R	Sensory	1	1	1	0	1	1	4
119	IL1VL	Sensory	1	1	1	0	1	1	4
120	IL1VR	Sensory	1	1	1	0	1	1	4
121	IL2DL	Sensory	0	1	0	0	1	1	5
122	IL2DR	Sensory	0	1	0	0	1	1	5
123	IL2L	Sensory	1	1	1	0	1	1	4
124	IL2R	Sensory	1	1	1	0	1	1	4
125	IL2VL	Sensory	0	1	1	0	1	1	5
126	IL2VR	Sensory	0	1	1	0	1	1	5
127	LUAL	Interneuron	1	1	1	0	1	2	6
128	LUAR	Interneuron	1	1	1	0	1	2	7
129	OLLL	Sensory	1	1	1	0	1	1	1
130	OLLR	Sensory	1	1	1	0	1	1	1
131	OLQDL	Sensory	1	1	1	0	1	1	3
132	OLQDR	Sensory	1	1	1	0	1	1	3
133	OLQVL	Sensory	1	1	1	0	1	1	3
134	OLQVR	Sensory	1	1	1	0	1	1	3
135	PDA	Motor	1	1	1	0	1	2	7
136	PDB	Motor	1	1	1	0	0	2	7
137	PDEL	Sensory	1	1	1	1	1	5	3
138	PDER	Sensory	1	1	1	1	1	5	3
139	PHAL	Sensory	1	1	1	0	1	8	3
140	PHAR	Sensory	1	1	1	0	1	8	3
141	PHBL	Sensory	1	1	1	0	1	2	1
142	PHBR	Sensory	1	1	1	0	1	2	1
143	PHCL	Sensory	1	1	1	0	1	2	6
144	PHCR	Sensory	1	1	0	0	1	2	6
145	PLML	Sensory	1	1	0	0	1	2	6

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	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
146	PLMR	Sensory	1	1	1	0	1	5	6
147	PLNL	Interneuron	0	1	1	0	1	3	5
148	PLNR	Interneuron	0	1	0	0	1	3	5
149	PQR	Sensory	1	1	1	0	1	2	3
150	PVCL	Sensory	1	1	1	0	1	2	6
151	PVCR	Sensory	1	1	1	0	1	2	6
152	PVDL	Interneuron	0	1	1	0	1	2	5
153	PVDR	Interneuron	0	1	0	0	1	2	5
154	PVM	Sensory	1	1	1	0	0	5	3
155	PVNL	Interneuron	1	1	1	0	0	2	7
156	PVNR	Interneuron	1	1	1	0	0	2	2
157	PVPL	Interneuron	1	1	1	0	0	5	3
158	PVPR	Interneuron	1	1	1	0	0	5	3
159	PVQL	Interneuron	1	1	1	0	1	3	4
160	PVQR	Interneuron	1	1	1	0	1	3	1
161	PVR	Interneuron	1	1	1	0	0	5	6
162	PVT	Interneuron	1	1	1	0	1	5	3
163	PVWL	Interneuron	1	1	1	0	0	2	6
164	PVWR	Interneuron	1	1	1	0	0	2	7
165	RIAL	Interneuron	0	1	1	0	1	1	3
166	RIAR	Interneuron	0	1	1	0	1	1	1
167	RIBL	Interneuron	1	1	1	0	1	1	3
168	RIBR	Interneuron	1	1	1	0	1	1	3
169	RICL	Interneuron	1	1	1	1	1	1	1
170	RICR	Interneuron	1	1	1	1	1	1	1
171	RID	Interneuron	1	1	1	0	1	6	6
172	RIFL	Interneuron	1	1	1	0	0	6	3
173	RIFR	Interneuron	1	1	1	0	0	6	1
174	RIGL	Interneuron	1	1	1	0	0	1	3
175	RIGR	Interneuron	1	1	1	0	0	1	3
176	RIH	Interneuron	1	1	1	0	0	1	3
177	RIML	Motor	1	1	1	1	1	3	3
178	RIMR	Motor	1	1	1	1	1	3	3
179	RIPL	Interneuron	1	1	1	0	0	1	4
180	RIPR	Interneuron	1	1	1	0	0	1	4
181	RIR	Interneuron	1	1	1	0	0	1	3
182	RIS	Interneuron	1	1	1	0	1	1	3

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	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
183	RIVL	Interneuron	1	1	1	0	0	1	7
184	RIVR	Interneuron	1	1	1	0	0	1	7
185	RMDDL	Motor	1	1	1	0	1	1	3
186	RMDDR	Motor	1	1	1	0	1	1	3
187	RMDL	Motor	1	1	1	0	1	1	3
188	RMDR	Motor	1	1	1	0	1	1	3
189	RMDVL	Motor	1	1	1	0	1	1	3
190	RMDVR	Motor	1	1	1	0	1	1	3
191	RMED	Motor	1	1	1	0	1	1	1
192	RMEL	Motor	1	0	1	0	1	1	1
193	RMER	Motor	1	0	1	0	1	1	1
194	RMEV	Motor	1	1	1	0	1	1	1
195	RMFL	Motor	1	1	1	0	1	5	3
196	RMFR	Motor	0	1	1	0	1	5	4
197	RMGL	Interneuron	1	1	1	0	0	1	4
198	RMGR	Interneuron	1	1	1	0	0	1	4
199	RMHL	Motor	1	1	1	0	1	1	4
200	RMHR	Motor	1	1	1	0	1	1	4
201	SAADL	Interneuron	1	1	1	0	0	3	3
202	SAADR	Interneuron	1	1	1	0	0	3	3
203	SAAVL	Interneuron	1	1	1	0	0	3	3
204	SAAVR	Interneuron	1	1	1	0	0	2	3
205	SABD	Interneuron	1	1	1	0	1	7	6
206	SABVL	Interneuron	1	0	1	0	1	2	6
207	SABVR	Interneuron	1	0	1	0	1	7	6
208	SDQL	Interneuron	1	1	1	0	1	2	3
209	SDQR	Interneuron	1	1	0	0	1	6	6
210	SIADL	Interneuron	1	0	1	0	1	1	3
211	SIADR	Interneuron	1	0	1	0	1	1	3
212	SIAVL	Interneuron	1	0	1	0	1	1	7
213	SIAVR	Interneuron	1	0	1	0	1	1	7
214	SIBDL	Interneuron	1	0	1	0	1	1	7
215	SIBDR	Interneuron	1	0	1	0	1	1	3
216	SIBVL	Interneuron	1	0	1	0	1	6	6
217	SIBVR	Interneuron	1	0	1	0	1	1	3
218	SMBDL	Motor	1	1	1	0	0	5	3
219	SMBDR	Motor	1	1	1	0	0	5	3

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	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
220	SMBVL	Motor	1	1	1	0	0	3	3
221	SMBVR	Motor	1	1	1	0	0	3	3
222	SMDDL	Motor	1	1	1	0	1	1	3
223	SMDDR	Motor	1	1	1	0	1	1	3
224	SMDVL	Motor	1	1	1	0	1	1	3
225	SMDVR	Motor	1	1	1	0	1	1	3
226	URADL	Motor	0	1	1	0	0	1	8
227	URADR	Motor	0	1	1	0	0	1	5
228	URAVL	Motor	0	1	1	0	0	1	5
229	URAVR	Motor	0	1	1	0	0	1	5
230	URBL	Sensory	1	1	1	0	0	1	3
231	URBR	Sensory	1	1	1	0	0	1	3
232	URXL	Sensory	1	1	1	0	0	1	4
233	URXR	Sensory	1	1	1	0	0	1	4
234	URYDL	Sensory	1	1	1	0	1	1	6
235	URYDR	Sensory	1	1	1	0	1	1	6
236	URYVL	Sensory	1	1	1	0	1	1	6
237	URYVR	Sensory	1	1	1	0	1	1	6
238	VA01	Motor	1	1	1	0	1	7	6
239	VA02	Motor	1	1	1	0	1	7	6
240	VA03	Motor	1	1	1	0	1	7	6
241	VA04	Motor	1	1	1	0	1	4	6
242	VA05	Motor	1	1	1	0	1	4	6
243	VA06	Motor	1	1	1	0	1	4	6
244	VA07	Motor	1	1	1	0	1	4	6
245	VA08	Motor	1	1	1	0	1	2	6
246	VA09	Motor	1	1	1	0	1	6	6
247	VA10	Motor	1	0	1	0	1	2	6
248	VA11	Motor	1	1	1	0	1	2	6
249	VA12	Motor	1	1	1	0	1	2	6
250	VB01	Motor	1	1	1	0	1	7	6
251	VB02	Motor	1	1	1	0	1	7	6
252	VB03	Motor	1	1	1	0	1	4	6
253	VB04	Motor	1	1	1	0	1	4	6
254	VB05	Motor	1	1	1	0	1	4	6
255	VB06	Motor	1	1	1	0	1	4	6
256	VB07	Motor	1	1	1	0	1	6	6

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Table S1: Neuron names and their characteristics. EN: Electrical Neuron. CS: Chemical Source. CT: Chemical Target. WS: Wireless Source. WT: Wireless Target. PMLC: Partition "Multilayer-Louvain" Community. PDCBC: Partition "dynamical correlation-based" Community.

	Neuron	Function	EN	CS	CT	WS	WT	PMLC	PDCBC
257	VB08	Motor	1	1	1	0	1	6	6
258	VB09	Motor	1	1	1	0	1	6	6
259	VB10	Motor	1	1	1	0	1	2	6
260	VB11	Motor	1	1	1	0	1	2	6
261	VC01	Motor	1	1	1	0	0	4	1
262	VC02	Motor	1	1	1	0	0	4	4
263	VC03	Motor	1	1	1	0	0	4	4
264	VC04	Motor	1	1	1	0	0	4	4
265	VC05	Motor	1	1	1	0	0	4	4
266	VD01	Motor	1	1	1	0	1	7	3
267	VD02	Motor	1	1	1	0	1	7	3
268	VD03	Motor	1	1	1	0	1	4	3
269	VD04	Motor	1	0	1	0	1	4	3
270	VD05	Motor	1	1	1	0	1	4	3
271	VD06	Motor	1	1	1	0	1	4	3
272	VD07	Motor	1	0	1	0	1	4	7
273	VD08	Motor	1	1	1	0	1	2	7
274	VD09	Motor	1	0	1	0	1	6	3
275	VD10	Motor	1	1	1	0	1	6	3
276	VD11	Motor	0	1	1	0	1	2	8
277	VD12	Motor	0	1	1	0	1	2	1
278	VD13	Motor	1	1	1	0	1	2	3