Table S1. Population parameters for network model with adjusted (Δ) and additional (+) neuronal populations modified from Rybak et al. 2008.

		Population name	Size	Resting theshold (mV)	THO variability (mV)	Membrane time constant	Post-spike increase in G_{K+}	Post-spike G_{K+} time constant (ms)	Adaptation threshold increase	Adaptation (ms)	Noise amplitude	DC (mV)
			N	*THO*		*TMEM*	*B*	*TGK*	*C*	*TTH*		
		PRG I	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.03	2.0
		PRG rIE	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.3	5.0
		PRG cIE	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.3	5.0
		PRG E	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.3	13.0
		PRG EI	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.3	20.0
		PRG NRM	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.03	25.0
		VRC NRM	300	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.03	25.0
		I-DRIVER	300	see Table 2 for I-Driver neuron parameters								
	Δ	I-DEC	300	10.0	1.0	6.0	25.5	6.63	0.63	1000.0	0.3	36.0
		I-AUG	300	10.0	1.0	6.0	25.0	3.8	0.0	5000.0	0.5	8.0
		VRC IE	99	10.0	1.0	9.0	5.6	5.0	0.0	1000.0	0.054	12.0
	Δ	E-DEC-P	300	8.0	1.0	9.0	27.0	2.5	0.7	1200.0	0.1	18.0
		E-DEC-T	300	8.0	1.0	9.0	27.0	2.5	0.8	2000.0	0.3	0.0
		E-AUG-early	300	10.0	1.0	6.0	27.0	2.5	0.0	500.0	0.3	30.0
		E-AUG-late	300	10.0	1.0	9.0	27.0	2.5	0.0	500.0	0.1	27.0
		E-AUG-Cough	300	10.0	1.0	9.0	27.0	2.5	0.0	500.0	0.3	0.0
		E-AUG-BS	300	10.0	1.0	6.0	25.0	3.8	0.08	500.0	0.2	5.0
		Pump+	300	0.0	0.0	6.0	25.0	3.8	0.08	500.0	0.1	0.0
		Pump-	300	0.0	0.0	6.0	25.0	3.8	0.08	500.0	0.1	0.0
		I-AUG-BS/PHR	300	10.0	1.0	6.0	25.0	3.8	0.08	500.0	0.3	5.0
	Δ	Lum (Exp MN)	300	10.0	1.0	6.0	25.0	3.8	0.08	500.0	0.2	4.0
	Δ	ILM	300	10.0	1.0	6.0	25.0	3.8	0.08	500.0	0.1	0.0
	+	E-DEC-Pre	300	8.0	1.0	9.0	27.0	2.5	0.8	1000.0	0.1	9.0
	Δ	ELM	300	10.0	1.0	6.0	25.0	3.8	0.08	500.0	0.1	0.0
	+	LUNG PSRs	300	0.0	0.0	0.0	25.0	100.0	0.08	500.0	0.1	0.0
>		Second-order (cough)	100	10.0	1.0	9.0	20.0	7.0	0.3	500.0	0.1	0.0
	+	Second-order (deflation sensitive)	300	8.0	1.0	9.0	27.0	2.5	0.5	1000.0	0.3	20.0
>	+	Baro Raphe 8	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.01	0.0

		Population name	Size	Resting theshold (mV)	THO variability (mV)	Membrane time constant	Post-spike increase in G_{K+}	Post-spike G_{K+} time constant (ms)	Adaptation threshold increase	Adaptation (ms)	Noise amplitude	DC (mV)
			N	*THO*		*TMEM*	*B*	*TGK*	*C*	*TTH*		
>	+	Baro Raphe 28	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.1	0.0
	+	Baro Raphe 29	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.5	0.0
	+	Baro Raphe 30	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.5	0.0
	+	Baro Raphe 31	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.1	10.0
	+	Baro Raphe 32	100	10.0	1.0	9.0	20.0	7.0	0.0	500.0	0.1	10.0

Variable names used by MacGregor (1987) are in italics. All values representing voltages are relative to the resting potential, which is considered equal to zero. *N* is the number of neurons simulated in each population. *THO*, the resting threshold, is normally distributed in the population around the value of THO with a standard deviation equal to the "THO variability" value. *TMEM* is the membrane time constant. B is the amplitude of the post-spike increase in potassium conductance. *TGK* is the time constant of the potassium conductance decay following an action potential. *C* and *TTH* define the change in threshold associated with spike adaptation. *C* is the ratio of the threshold increase to the membrane potential increase; its value is between 0 and 1. *TTH* is the time constant of the rise in threshold with spike adaptation. *Noise Amplitude*: Each cell has an internal noise generator that acts like two synapses, one with an equilibrium potential of 70 mV above resting and the other with –70 mV. Each acts like it has an incoming firing probability of 0.05 per time step, and a synapse time constant of 1.5 ms. This parameter is the conductance that gets added to the synapse conductance on each (virtual) spike. *DC*: An injected current will raise the membrane potential by an amount that is inversely proportional to the membrane conductance. Instead of being specified directly as a current, this parameter is specified in mV, and it is interpreted as the current that is required to raise the membrane potential by the specified number of mV when the membrane conductance has its resting value. The effect on the membrane potential at other membrane conductances will be inversely proportional to the conductance. Note also that as in other types of IF neuron models, our neuron models do not actually generate action potential-like spikes but only identified moments of spikes, so "spiking" shown in all neuron simulations are represented graphically by assigning vertical spike-like lines at computed times of threshold crossing. Hypoxia neurons were not used and the population "E-Aug-Late-HT" in Rybak et al. 2008 has been renamed to "E-AUG-Cough" in the base model for this simulation. (>) neuron populations that relay perturbations of the network model. A fiber population consisting of 100 fibers, each with 100 excitatory synaptic terminals with a synaptic strength of 0.02 was used to represent cough receptor excitation; each fiber had a firing probability of 0.05 at each simulation time step. This fiber population excited a second-order "Cough" neuron population. A fiber population consisting of 100 fibers, each with 100 excitatory synaptic terminals with a synaptic strength of 0.01 was used to represent baroreceptor excitation; each fiber had a firing probability of 0.05 at each simulation time step. This fiber population excited the "Baro Raphé 8" and "Baro Raphé 28" neuron populations. For abbreviations see list of abbreviations and legend of figure 1 in the main text.

Table S2. I-Driver neuron parameters.

I-Driver Parameter	Value
Time constant for *h*	2000 ms
Half-voltage for *h*	-51 mV
NaP conductance	3.0 nS
Slope for *h*	5.0 mV
Half-voltage for activation	-43.0 mV
Slope for activation	-6.0 mV
Reset voltage @ $h = 0$	-42.0 mV
Threshold voltage	-37.0 mV
Applied current (I_{app})	0.0 pA
Noise amplitude	0.1 nS

The I-Driver neuron was modeled using the "hybrid IF conditional burster model" derived from Breen et al. (2003). All parameters in this model correspond to the Breen et al. model; *h* is the inactivation variable of the persistent sodium (NaP) channel. The following modifications of the original Breen et al. model were made: the *Threshold voltage* parameter was set constant (not dependent on *h*) and reset of *h* with each spike Δh $(h) = -0.00185h$.

Table S3. Simulated PSR population parameters for model networks.

PSR Population Parameter	Value
Rise time constant	500.0 ms
Fall time constant	100.0 ms

Lung volume dynamics were not directly simulated in our model. Input to the PSR population was formed via low-pass filtering of the output of the Phr population or I-Aug-BS/Phr population with rise and fall time constants given in the table.

Table S4. Connectivity for the network model modified from Rybak et al. 2008.

	Source Population	Target Population	Synaptic Type	Conduction Times Min.	Max.	No. of Terminals	Synaptic Strength	Source Popula-tion N	Target Popula-tion N	Divergence	Mean No. of Terminals	Convergence
	I-DRIVER	I-DEC	Ex_1	0	4	100	0.006	300	300	84.99 ± 3.14	1.18	84.99 ± 7.54
	I-DRIVER	I-AUG	Ex_1	0	5	100	0.005	300	300	84.98 ± 3.14	1.18	84.98 ± 7.44
	I-DRIVER	I-DRIVER	Ex_1	0	4	50	0.003	300	300	46.34 ± 1.76	1.08	46.34 ± 5.84
	E-DEC-P	I-DRIVER	Inh_2	0	5	100	0.015	300	300	85.2 ± 3.05	1.17	85.20 ± 9.59
	E-DEC-P	E-AUG-early	Inh_1	0	2	150	0.012	300	300	118.24 ± 4.01	1.27	118.24 ± 8.86
	E-DEC-P	E-AUG-late	Inh_1	2	4	150	0.02	300	300	118.1 ± 3.94	1.27	118.10 ± 9.61
	E-DEC-P	VRC IE	Inh_1	0	2	50	0.1	300	99	39.33 ± 2.31	1.27	119.18 ± 7.22
	E-DEC-P	I-DEC	Inh_1	0	2	200	0.2	300	300	146.07 ± 4.42	1.37	146.07 ± 8.71
	E-DEC-P	E-AUG BS	Inh_1	0	4	100	0.01	300	300	85.51 ± 3.01	1.17	85.51 ± 7.16
	E-DEC-P	I-AUG	Inh_1	0	2	50	0.1	300	300	46.19 ± 1.72	1.08	46.19 ± 5.43
	E-DEC-P	PRG rIE	Ex_1	2	4	100	0.001	300	100	63.13 ± 2.98	1.58	189.39 ± 6.74
	E-DEC-P	PRG cIE	Ex_1	2	4	100	0.001	300	100	63.23 ± 3.19	1.58	189.70 ± 9.56
	I-DEC	E-AUG-early	Inh_1	0	2	115	1.0	300	300	95.67 ± 3.39	1.20	95.67 ± 7.14
	I-DEC	E-DEC-P	Inh_1	0	5	200	0.2	300	300	145.80 ± 5.20	1.37	145.80 ± 9.31
	I-DEC	I-AUG	Inh_2	0	1	200	0.008	300	300	146.63 ± 4.89	1.36	146.63 ± 8.54
	I-DEC	E-AUG-late	Inh_2	0	5	115	1.0	300	300	95.71 ± 3.51	1.20	95.71 ± 7.84
	I-DEC	VRC IE	Inh_1	0	4	100	0.029	300	99	63.21 ± 3.10	1.58	191.54 ± 7.38
	I-DEC	E-DEC-T	Inh_1	0	5	100	0.05	300	300	84.9 ± 2.96	1.18	84.90 ± 9.43
	I-DEC	ILM	Ex_1	0	3	50	0.004	300	300	46.35 ± 1.71	1.08	46.35 ± 6.00
	I-DEC	E-AUG BS	Inh_1	0	4	100	0.02	300	300	85.44 ± 3.02	1.17	85.44 ± 9.96
	I-DEC	PRG EI	Ex_1	2	4	100	0.001	300	100	63.33 ± 3.16	1.58	190.00 ± 8.78
	I-DEC	PRG I	Ex_1	2	4	100	0.0005	300	100	63.5 ± 3.23	1.57	190.51 ± 8.03
	I-DEC	PRG I	Inh_2	2	4	100	0.0005	300	100	63.66 ± 3.21	1.57	190.98 ± 8.42
	I-DEC	PRG rIE	Inh_1	2	4	100	0.0001	300	100	63.55 ± 3.04	1.57	190.65 ± 8.05
	I-DEC	PRG cIE	Inh_2	2	4	100	0.0001	300	100	63.27 ± 3.06	1.58	189.80 ± 8.43
+	I-DEC	LUM (EXP MN)	Inh_1	0	4	100	0.1	300	300	84.96 ± 3.06	1.18	84.96 ± 8.23
+	I-DEC	E-Dec-Pre	Inh_1	0	5	200	0.2	300	300	146.12 ± 4.70	1.37	146.12 ± 8.41
	I-AUG	I-AUG	Ex_1	0	5	50	0.02	300	300	45.99 ± 1.77	1.09	45.99 ± 5.31
	I-AUG	PRG cIE	Inh_2	2	4	100	0.0001	300	100	63.43 ± 3.19	1.58	190.28 ± 9.05

	Source Population	Target Population	Synaptic Type	Conduction Times Min.	Max.	No. of Terminals	Synaptic Strength	Source Popula-tion N	Target Popula-tion N	Divergence	Mean No. of Terminals	Convergence
	I-AUG	I-AUG BS/Phrenic	Ex_1	0	3	200	0.06	300	300	146.05 ± 4.72	1.37	146.05 ± 9.65
	I-AUG	ILM	Ex_1	0	3	50	0.03	300	300	46.35 ± 1.71	1.08	46.35 ± 6.00
	I-AUG	VRC IE	Ex_1	0	5	100	0.003	300	99	63.05 ± 3.25	1.59	191.06 ± 7.37
	I-AUG	PRG I	Ex_1	2	4	100	0.0025	300	100	63.59 ± 2.94	1.57	190.76 ± 7.71
	I-AUG	PRG rIE	Inh_1	2	4	100	0.0001	300	100	63.43 ± 2.95	1.58	190.29 ± 8.57
	I-AUG	E-AUG BS	Inh_1	0	4	1000	0.1	300	300	289.42 ± 2.98	3.46	289.42 ± 2.86
+	I-AUG	LUM (EXP MN)	Inh_1	0	4	100	0.1	300	300	85.08 ± 3.20	1.18	85.08 ± 7.10
	E-AUG-early	E-DEC-P	Inh_1	0	2	110	0.014	300	300	91.85 ± 3.43	1.20	91.85 ± 8.07
	E-AUG-early	I-DEC	Inh_1	0	5	100	0.06	300	300	85.13 ± 2.98	1.17	85.13 ± 7.70
	E-AUG-early	I-AUG	Inh_1	0	2	150	0.06	300	300	118.48 ± 4.08	1.27	118.48 ± 8.37
	E-AUG-early	VRC IE	Inh_1	0	2	24	0.05	300	99	21.46 ± 1.29	1.12	65.02 ± 6.96
	E-AUG-early	I-AUG BS/Phrenic	Inh_1	0	2	150	0.001	300	300	118.31 ± 4.21	1.27	118.31 ± 7.57
	E-AUG-early	E-DEC-T	Inh_1	0	2	100	0.05	300	300	85.13 ± 2.94	1.17	85.13 ± 9.11
	E-AUG-early	E-AUG-late	Inh_1	0	2	50	0.001	300	300	46.01 ± 1.81	1.09	46.01 ± 6.57
+	E-AUG-early	E-Dec-Pre	Inh_1	0	2	110	0.014	300	300	92.51 ± 3.15	1.19	92.51 ± 8.03
	E-AUG-early	PRG E	Ex_1	2	4	100	0.002	300	100	63.08 ± 2.85	1.59	189.25 ± 7.68
	E-AUG-early	E-AUG BS	Ex_1	0	3	50	0.02	300	300	46.35 ± 1.71	1.08	46.35 ± 6.00
	E-AUG-early	PRG I	Inh_2	2	4	100	0.0005	300	100	63.08 ± 2.85	1.59	189.25 ± 7.68
	E-AUG-late	E-AUG-early	Inh_1	0	2	200	0.04	300	300	145.91 ± 4.71	1.37	145.91 ± 9.07
	E-AUG-late	I-DEC	Inh_1	0	4	55	0.01	300	300	50.33 ± 1.87	1.09	50.33 ± 6.68
	E-AUG-late	I-AUG	Inh_1	0	2	150	0.06	300	300	118.09 ± 3.79	1.27	118.09 ± 7.65
	E-AUG-late	E-DEC-P	Inh_1	0	2	115	0.014	300	300	95.57 ± 3.26	1.20	95.57 ± 9.85
	E-AUG-late	I-AUG BS/Phrenic	Inh_1	0	2	150	0.002	300	300	118.14 ± 4.18	1.27	118.14 ± 8.44
	E-AUG-late	VRC IE	Inh_1	0	2	24	0.02	300	99	21.32 ± 1.39	1.13	64.62 ± 7.03
	E-AUG-late	E-DEC-T	Inh_1	0	2	100	0.05	300	300	85.18 ± 3.01	1.17	85.18 ± 6.53
	E-AUG-late	E-AUG BS	Inh_1	0	4	100	0.015	300	300	85.16 ± 3.38	1.17	85.16 ± 10.32
	E-AUG-late	E-AUG-Cough	Ex_1	0	3	50	0.01	300	300	45.99 ± 1.70	1.09	45.99 ± 6.08
+	E-AUG-late	E-Dec-Pre	Inh_1	0	2	115	0.04	300	300	95.69 ± 3.35	1.20	95.69 ± 7.07
	E-AUG-late	ELM	Inh_1	2	4	500	0.12	300	300	243.18 ± 5.04	2.06	243.18 ± 7.13
	VRC IE	I-DEC	Inh_2	0	4	200	0.05	99	300	146.65 ± 4.99	1.36	48.39 ± 5.40
	VRC IE	I-AUG	Inh_2	0	5	200	0.02	99	300	146.07 ± 4.45	1.37	48.20 ± 4.92
	I-AUG BS/Phrenic	LUNG PSRs	Ex_1	0	3	100	0.016	300	300	84.91 ± 3.04	1.18	84.91 ± 8.03
	NRM BötC	PRG rIE	Inh_2	0	1	100	0.002	300	100	63.41 ± 3.22	1.58	190.23 ± 7.92
	NRM BötC	PRG cIE	Inh_2	0	1	100	0.002	300	100	63.37 ± 3.02	1.58	190.12 ± 7.75

	Source Population	Target Population	Synaptic Type	Conduction Times Min.	Max.	No. of Terminals	Synaptic Strength	Source Popula-tion N	Target Popula-tion N	Divergence	Mean No. of Terminals	Convergence
	NRM BötC	PRG I	Ex_1	0	1	100	0.002	300	100	63.25 ± 3.00	1.58	189.74 ± 8.31
	E-AUG-Cough	E-AUG BS	Inh_1	0	3	600	0.1	300	300	259.67 ± 4.67	2.31	259.67 ± 5.85
+	E-AUG-Cough	LUM (EXP MN)	Inh_1	0	4	500	0.1	300	300	243.68 ± 5.27	2.05	243.68 ± 6.90
+	E-AUG-Cough	ELM	Inh_1	0	3	600	0.25	300	300	259.29 ± 4.63	2.31	259.29 ± 5.84
+	E-AUG-Cough	E-Dec-Pre	Inh_1	0	3	600	0.25	300	300	259.38 ± 4.97	2.31	259.38 ± 6.01
	LUNG PSRs	Pump+	Ex_1	0	3	50	0.015	300	300	46.11 ± 1.76	1.08	46.11 ± 6.15
	LUNG PSRs	Pump-	Ex_1	0	3	50	0.015	300	300	46.23 ± 1.78	1.08	46.23 ± 9.43
	PRG cIE	I-DRIVER	Ex_1	0	5	100	0.001	100	300	85.68 ± 2.78	1.17	28.56 ± 4.45
	Pump-	PRG E	Pre	0	4	100	0.99	300	100	63.19 ± 2.88	1.58	189.58 ± 7.28
+	Pump-	Second-order (deflation sensitive)	Inh_1	0	4	100	0.02	300	300	85.21 ± 2.99	1.17	85.21 ± 6.50
	Pump-	I-DEC	Inh_1	0	2	25	0.0035	300	300	23.98 ± 0.90	1.04	23.98 ± 5.97
	Pump-	PRG I	Pre	0	4	100	0.99	300	100	63.53 ± 2.94	1.57	190.58 ± 7.02
	Pump-	PRG EI	Pre	2	4	100	0.99	300	100	63.55 ± 2.95	1.57	190.64 ± 7.44
	Pump-	PRG rIE	Pre	0	4	100	0.99	300	100	63.63 ± 3.02	1.57	190.88 ± 9.09
	Pump-	PRG cIE	Pre	0	4	100	0.99	300	100	63.63 ± 3.02	1.57	190.88 ± 9.09
	Pump+	E-DEC-P	Ex_1	0	2	100	0.01	300	300	85.47 ± 2.95	1.17	85.47 ± 8.14
	Pump+	VRC IE	Ex_1	0	2	100	0.004	300	99	63.10 ± 2.99	1.58	191.2 ± 11.2
	Pump+	I-AUG	Ex_1	0	2	25	0.002	300	300	24.07 ± 0.91	1.04	24.07 ± 4.15
	Pump+	E-DEC-T	Ex_1	0	2	100	0.002	300	300	85.12 ± 3.16	1.17	85.12 ± 6.94
	Pump+	E-AUG BS	Ex_1	0	4	100	0.008	300	300	85.19 ± 3.15	1.17	85.19 ± 7.24
+	E-DEC-T	Baro Raphé 29	Inh_1	0	3	100	0.001	300	100	63.59 ± 3.05	1.57	190.76 ± 7.20
	E-DEC-T	I-AUG BS/Phrenic	Inh_1	0	4	100	0.05	300	300	84.99 ± 3.14	1.18	84.99 ± 7.54
	E-DEC-T	PRG rIE	Ex_1	2	4	100	0.001	300	100	63.26 ± 3.11	1.58	189.77 ± 11.78
	E-DEC-T	PRG I	Ex_1	2	4	100	0.0005	300	100	63.33 ± 3.02	1.58	189.98 ± 9.72
	E-DEC-T	PRG I	Inh_2	2	4	100	0.0005	300	100	63.20 ± 3.13	1.58	189.60 ± 7.79
	E-DEC-T	PRG rIE	Inh_1	2	4	100	0.0005	300	100	63.57 ± 3.16	1.57	190.70 ± 7.57
	E-DEC-T	PRG cIE	Ex_1	2	4	100	0.001	300	100	63.20 ± 3.18	1.58	189.61 ± 7.72
	E-DEC-T	PRG cIE	Inh_2	2	4	100	0.0005	300	100	63.40 ± 3.17	1.58	190.20 ± 9.74
+	E-DEC-T	E-AUG BS	Inh_1	0	4	100	0.05	300	300	85.16 ± 3.08	1.17	85.16 ± 8.54
+	E-DEC-T	ELM	Inh_1	0	4	100	0.04	300	300	85.04 ± 3.30	1.18	85.04 ± 8.24
+	E-DEC-T	I-AUG	Inh_1	0	4	100	0.0075	300	300	85.12 ± 3.35	1.17	85.12 ± 8.17
	PRG rIE	PRG EI	Inh_1	2	4	100	0.03	100	100	63.79 ± 3.24	1.57	63.79 ± 4.98
	PRG rIE	VRC IE	Ex_1	0	1	100	0.001	100	99	62.90 ± 3.28	1.59	63.54 ± 4.65

		Source Population	Target Population	Synaptic Type	Conduction Times Min.	Max.	No. of Terminals	Synaptic Strength	Source Popula-tion N	Target Popula-tion N	Divergence	Mean No. of Terminals	Convergence
		PRG rIE	E-DEC-P	Ex_1	0	5	100	0.02	100	300	85.06 ± 2.76	1.18	28.35 ± 4.15
		PRG EI	PRG rIE	Ex_1	2	4	100	0.002	100	100	63.47 ± 3.20	1.58	63.47 ± 4.78
		PRG EI	PRG cIE	Ex_1	2	4	100	0.002	100	100	63.36 ± 3.47	1.58	63.36 ± 4.41
		PRG EI	VRC IE	Ex_1	0	4	50	0.0003	100	99	39.46 ± 2.35	1.27	39.86 ± 5.11
		PRG EI	E-DEC-T	Ex_1	0	4	100	0.01	100	300	85.16 ± 3.33	1.17	28.39 ± 5.10
	+	E-Dec-Pre	ELM	Ex_1	2	4	150	0.0075	300	300	118.11 ± 3.99	1.27	118.11 ± 7.38
>	+	Baro Raphé 8	Baro Raphé 29	Ex_1	0	3	50	0.0125	100	100	39.73 ± 2.28	1.26	39.73 ± 5.01
>	+	Baro Raphé 8	Baro Raphé 30	Ex_1	0	3	50	0.0125	100	100	39.51 ± 2.47	1.27	39.51 ± 4.93
>	+	Baro Raphé 28	Baro Raphé 31	Inh_1	0	3	50	0.005	100	100	39.38 ± 2.09	1.27	39.38 ± 6.21
>	+	Baro Raphé 28	Baro Raphé 32	Inh_1	0	3	50	0.005	100	100	39.51 ± 2.47	1.27	39.51 ± 4.93
>	+	Baro Raphé 28	E-AUG BS	Inh_4	0	3	400	0.04	100	300	221.45 ± 4.77	1.81	73.82 ± 4.47
	+	Baro Raphé 29	Baro Raphé 30	Ex_1	0	3	50	0.01	100	100	39.51 ± 2.47	1.27	39.51 ± 4.93
	+	Baro Raphé 29	E-DEC-T	Ex_3	0	3	100	0.12	100	300	84.74 ± 3.12	1.18	28.25 ± 4.23
	+	Baro Raphé 29	E-DEC-P	Ex_3	0	3	100	0.2	100	300	84.74 ± 3.12	1.18	28.25 ± 4.23
	+	Baro Raphé 30	Baro Raphé 29	Inh_1	0	3	50	0.01	100	100	39.51 ± 2.47	1.27	39.51 ± 4.93
	+	Baro Raphé 32	Baro Raphé 31	Inh_1	0	3	50	0.005	100	100	39.51 ± 2.47	1.27	39.51 ± 4.93
	+	Baro Raphé 32	E-DEC-T	Inh_4	0	3	100	0.01	100	300	85.28 ± 3.13	1.17	28.43 ± 4.65
	+	Baro Raphé 32	E-DEC-P	Inh_4	0	3	100	0.01	100	300	84.74 ± 3.12	1.18	28.25 ± 4.23
	+	Baro Raphé 32	E-Dec-Pre	Inh_4	0	3	100	0.01	100	300	84.74 ± 2.97	1.18	28.25 ± 4.67
>		Second order (cough)	I-DEC	Ex_1	0	3	100	0.038	100	300	85.25 ± 2.83	1.17	28.42 ± 5.15
>		Second order (cough)	I-AUG	Ex_1	0	3	100	0.02	100	300	85.25 ± 2.83	1.17	28.42 ± 5.15
>		Second order (cough)	E-DEC-P	Ex_1	0	3	100	0.015	100	300	85.25 ± 2.83	1.17	28.42 ± 5.15
>		Second order (cough)	E-AUG-early	Ex_1	0	3	100	0.1	100	300	85.25 ± 2.83	1.17	28.42 ± 5.15
>		Second order (cough)	E-AUG-late	Ex_1	0	3	100	0.06	100	300	85.25 ± 2.83	1.17	28.42 ± 5.15
>		Second order (cough)	E-AUG BS	Ex_1	0	4	125	0.001	100	300	102.81 ± 3.59	1.22	34.27 ± 4.61
>		Second order (cough)	Pump-	Inh_1	0	4	250	0.4	100	300	170.45 ± 4.98	1.47	56.82 ± 4.58
>		Second order (cough)	VRC IE	Inh_1	0	3	100	0.2	100	99	63.13 ± 3.05	1.58	63.77 ± 5.20
>		Second order (cough)	PRG cIE	Ex_1	0	3	100	0.001	100	100	63.59 ± 3.21	1.57	63.59 ± 5.84
>		Second order (cough)	PRG rIE	Ex_1	0	3	100	0.001	100	100	63.59 ± 3.21	1.57	63.59 ± 5.84
>		Second order (cough)	PRG I	Ex_1	0	3	100	0.001	100	100	63.59 ± 3.21	1.57	63.59 ± 5.84
>		Second order (cough)	PRG E	Ex_1	0	3	100	0.001	100	100	63.59 ± 3.21	1.57	63.59 ± 5.84
>		Second order (cough)	PRG EI	Ex_1	0	3	100	0.001	100	100	63.59 ± 3.21	1.57	63.59 ± 5.84
>	+	Second order (cough)	E-Dec-Pre	Ex_1	0	3	100	0.0025	100	300	85.14 ± 3.06	1.17	28.38 ± 3.97
		PRG E	PRG rIE	Inh_1	2	4	100	0.0001	100	100	63.17 ± 3.15	1.58	63.17 ± 5.22

	Source Population	Target Population	Synaptic Type	Conduction Times Min.	Max.	No. of Terminals	Synaptic Strength	Source Popula-tion N	Target Popula-tion N	Divergence	Mean No. of Terminals	Convergence
	PRG E	PRG cIE	Inh_1	2	4	100	0.0001	100	100	63.47 ± 3.13	1.58	63.47 ± 5.60
	PRG E	I-DEC	Inh_1	0	1	100	0.008	100	300	85.14 ± 3.03	1.17	28.38 ± 4.11
	PRG NRM	PRG I	Ex_1	0	4	100	0.015	100	100	63.26 ± 3.28	1.58	63.26 ± 4.40
	PRG NRM	PRG I	Inh_1	0	4	100	0.05	100	100	63.62 ± 3.11	1.57	63.62 ± 4.61
	PRG NRM	I-DRIVER	Ex_1	0	5	100	0.12	100	300	85.10 ± 3.00	1.18	28.37 ± 4.51
	PRG NRM	VRC IE	Ex_1	0	1	100	0.01	100	99	63.02 ± 2.53	1.59	63.66 ± 4.67
	PRG NRM	I-AUG	Ex_1	0	1	100	0.01	100	300	85.21 ± 2.94	1.17	28.40 ± 4.81
	PRG NRM	E-AUG-early	Ex_1	0	4	100	0.025	100	300	85.82 ± 3.10	1.17	28.61 ± 4.20
	PRG NRM	E-AUG-late	Ex_1	0	4	50	0.003	100	300	45.82 ± 1.89	1.09	12.27 ± 3.67
	PRG NRM	E-DEC-P	Ex_1	0	1	100	0.01	100	300	84.87 ± 3.22	1.18	28.29 ± 4.18
	PRG NRM	E-DEC-T	Ex_1	0	1	100	0.1	100	300	85.35 ± 3.04	1.17	28.45 ± 4.06
	PRG NRM	NRM BötC	Inh_1	0	1	100	0.001	100	300	85.11 ± 2.96	1.17	28.37 ± 5.07
+	PRG NRM	E-Dec-Pre	Ex_1	0	1	100	0.01	100	300	85.12 ± 2.61	1.17	28.37 ± 4.46
	E-AUG BS	LUM (EXP MN)	Ex_1	0	4	100	0.03	300	300	85.19 ± 3.15	1.17	85.19 ± 7.24
	PRG I	PRG rIE	Ex_1	0	4	100	0.005	100	100	62.93 ± 2.89	1.59	62.93 ± 5.56
	PRG I	VRC IE	Ex_1	0	5	100	0.005	100	99	63.61 ± 3.41	1.57	64.25 ± 4.84
	PRG I	I-AUG	Ex_1	0	4	50	0.005	100	300	46.17 ± 1.67	1.08	12.39 ± 3.39
	PRG I	PRG cIE	Ex_1	0	4	100	0.005	100	100	63.67 ± 2.85	1.57	63.67 ± 4.57
+	Second-order (deflation sensitive)	E-DEC-P	Inh_1	2	6	100	0.04	300	300	85.17 ± 3.11	1.17	85.17 ± 9.16

(+) connection added to the network in Rybak et al. 2008. (>) connection relaying a perturbation to the network model. Connections between individual neurons were made according to a sequence of pseudorandom numbers calculated from a unique seed number for each source-to-target connection. Targets were chosen with replacement. This table includes the means ± SD of the number of neurons in each target population innervated by each source neuron in each population. Corresponding values are also shown for source neurons that innervated each target neuron in each population. These data indicate the extent of divergence and convergence, respectively. Most neurons in each source population made a single terminal connection with each target neuron. *Mean No. of Terminals*, the mean number of terminals from each source neuron innervating each target neuron. The efficacy of connections between populations of neurons was influenced by the change in conductance associated with each action potential at a synapse (*Synaptic Strength*) and the number of terminals for each axon. *Synaptic types* were distinguished by their equilibrium potentials and time constants. The time constant of some synapses was slightly longer than others because troughs in cross-correlograms from which the particular synaptic connections were inferred tended to have longer durations. Six types of synapses were used in

the simulation: type 1 excitatory (Ex_1, equilibrium potential of 115.0 mV; time constant, 1.5 ms); type 3 excitatory (Ex_3, equilibrium potential, 115.0 mV; time constant, 5.0 ms); type 1 inhibitory (Inh_1, equilibrium potential, -25.0 mV; time constant, 1.5 ms); type 2 inhibitory (Inh_2, equilibrium potential, -25.0 mV; time constant, 2.0 ms); type 4 inhibitory (Inh_4, equilibrium potential, -25.0 mV; time constant, 5.0 ms); pre-synaptic modulation (Pre, time constant, 1.5 ms). If the value of the pre-synaptic modulatory strength parameter (*Synaptic Strength*) was <1.0, the strength of the connection it modulates was reduced to the product of the presynaptic Synaptic Strength parameter and target synapse conductance. If the presynaptic Synaptic Strength parameter was >1.0, the amount by which it was greater than 1 is added to its target synapse's conductance. *Minimum and maximum conduction times* are expressed in 0.5-ms simulation clock ticks for each source-to-target axon population. *No. of Terminals*, number of terminals from source neuron.