

Supporting Information

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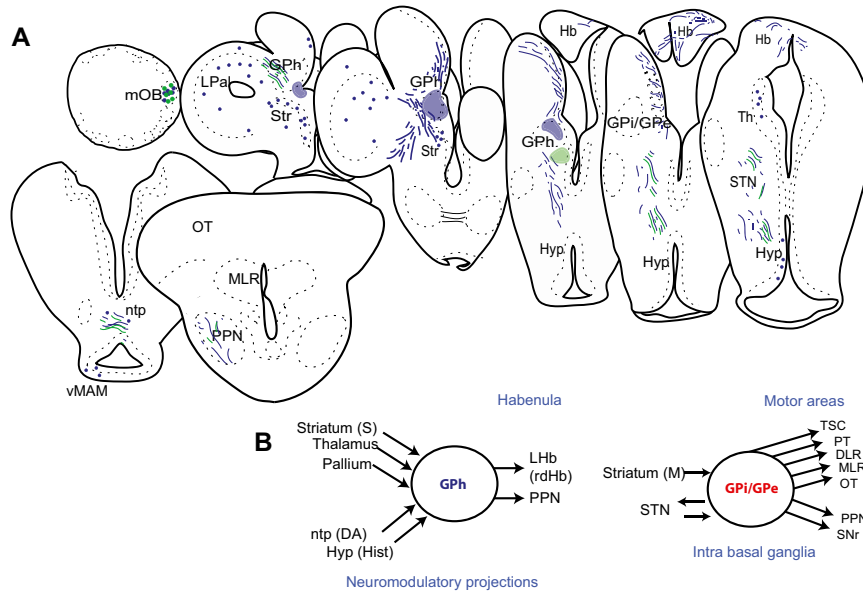


Fig. S1. Related to Fig. 3. (A) Schematic transverse sections through the lamprey brain showing the location of retrogradely labeled cells (green and blue dots) and labeled fibers (green and blue lines) from two injection sites (neurobiotin) into the habenula-projecting globus pallidus (GPh) (blue) and an area caudodorsal to this nucleus (green). Note that the injection in the GPh (blue) gives rise to labeled striatal cells, whereas the green injection does not. (B) Schematic drawing of the connectivity of the GPh and GPI/GPe. DA, dopamine; DLR, diencephalic locomotor region; Hist, histamine; Hyp, hypothalamus; Hb, habenula; LHb, lateral habenula; LPal, lateral pallium; MLR, mesencephalic locomotor region; mOB, medial olfactory bulb; ntp, nucleus of the tuberculi posterior; OT, optic tectum; PPN, pedunculopontine nucleus; PT, pretectum; SNr, substantia nigra pars reticulata; STN, subthalamic nucleus; Str, striatum; Th, thalamus; TSC, torus semicircularis.

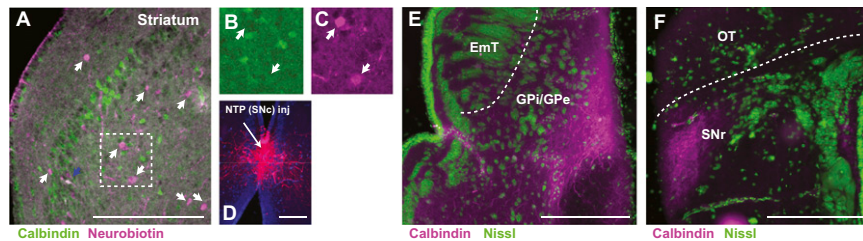


Fig. S2. Related to Fig. 4. Striatal neurons that do not express calbindin project to the dopaminergic nucleus tuberculi posterior [substantia nigra pars compacta/ventral tegmental area (SNc/VTA)]. (A–C) Neurobiotin retrogradely labeled neurons following an injection in the nucleus tuberculi posterior (pink) (D) and calbindin-immunoreactive neurons (green) in the striatum (Str). (E and F) Photomicrographs showing calbindin immunoreactive fibers in the GPI/GPe and substantia nigra pars reticulata (SNr). (Scale bars: A and D–F, 200 μ m.)

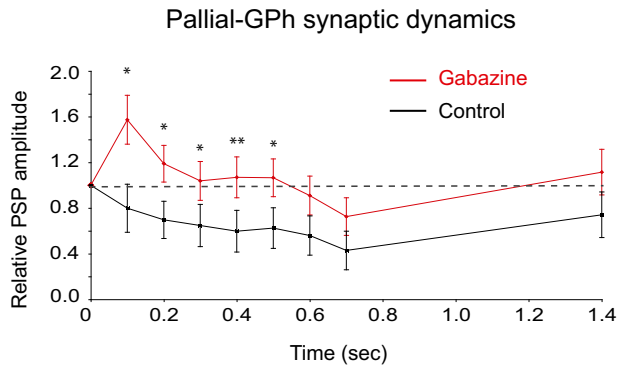


Fig. S3. Related to Fig. 5. Graph showing the relative amplitude of the postsynaptic potentials evoked in GPh neurons from pallial stimulation before (black) and after (red) the application of the GABA_A receptor antagonist gabazine (10 μM).

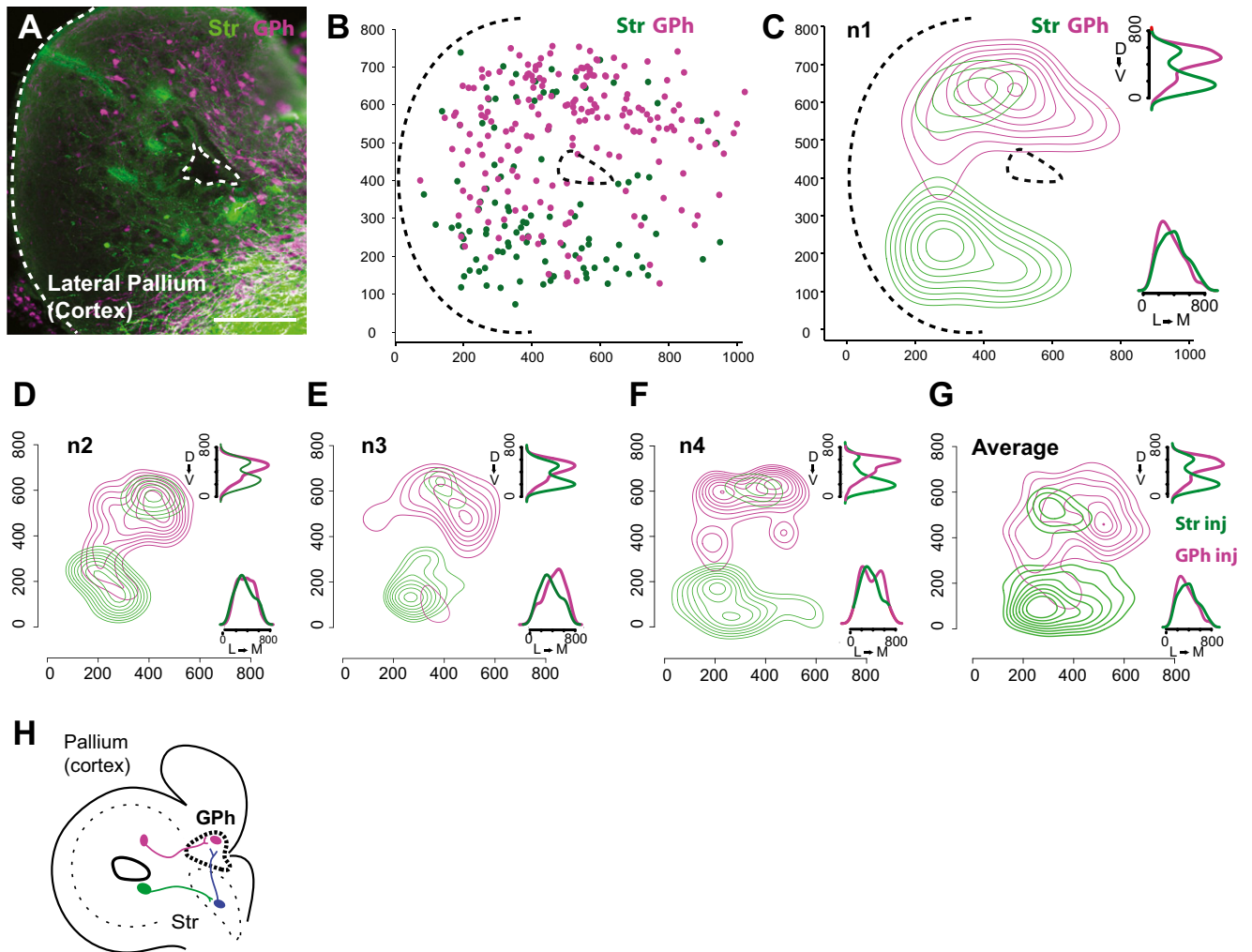


Fig. S4. Related to Fig. 5. The pallio-striatal and pallio-pallidal projections arise from separate populations of pallial neurons. (A) Photomicrograph showing the location of retrogradely labeled neurons following injections in the GPh (magenta) and striatum (green). (B) Graph showing the location of all retrogradely labeled neurons in one animal plotted with respect to the ventral and lateral borders of the lateral pallium. (C–G) Contour plots resulting from 2D kernel density estimations. Contour lines connect points of equal densities and are drawn for density values between 20% and 100% of the estimated density range, in steps of 10%. C–F each represent data from an individual animal, whereas G is the average of the four animals. (H) Schematic drawing of a transverse section through the lateral pallium showing the connections of the two populations of pallial neurons. (Scale bar: A, 200 μm.)

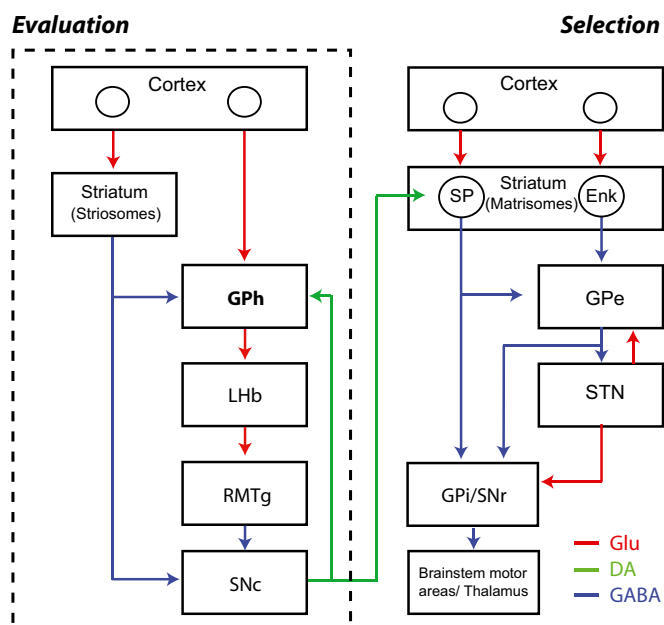


Fig. S5. Related to *Discussion*. Schematic drawing showing the classic “direct” and “indirect” circuitry for selection (*Right*) and the evaluation circuit that we describe here on the left. DA, dopamine; Enk, enkephalin; Glu, glutamate; GPi, globus pallidus interna; GPe, globus pallidus externa; LHb, lateral habenula; RMTg, rostromedial tegmental nucleus; SNc, substantia nigra pars compacta; SNr, substantia nigra pars reticulata; SP, substance P; STN, subthalamic nucleus.

Table S1. Comparison of cellular properties of lamprey GPe and GPi/GPe neurons

Cellular properties	GPe	GPi/GPe	<i>P</i>
Neurons, <i>n</i>	14	8	—
Resting membrane potential, mV	-61.8 ± 6.2	-68.1 ± 4.4	0.024
Input resistance, $G\Omega$	4.6 ± 2.2	1.5 ± 1.2	0.0003
Membrane time constant, ms	173.6 ± 83.2	76.4 ± 38.3	0.001
Mean firing frequency, Hz	1.3 ± 1.3	1.8 ± 1.0	0.37
Action potential threshold, mV	-44.3 ± 5.1	-46.6 ± 4.7	0.88
Action potential half width, ms	7.9 ± 1.8	3.4 ± 1.4	0.0001
Action potential amplitude, mV	55.8 ± 8.5	61.7 ± 8.7	0.18
Action potential peak, mV	9.1 ± 7.6	15.1 ± 7.7	0.07
Postinhibitory rebound, <i>n</i>	5/8	5/13	—
Voltage-dependent sag, <i>n</i>	1/13	4/8	—

The dashes in the fourth column indicate that *P* values are not applicable.