









Supplementary Figure 1. (A) Recording depth of GPe and GPi task-modulated neurons.

Black and grey represent neurons judged to be in GPe and GPi, respectively. The numbers above the arrowheads indicate the means of the distributions of GPe and GPi recording depths. Recording depth was measured relative to the top of GPe.

(B) Average (mean  $\pm$  SE) of the Reward-Visual Index (RVI) for the same neurons. The numbers by the arrowheads indicate the overall mean RVI for GPe (black), which was not different from 0 ( $p > 0.05$ ), and for GPi (grey), which was significantly greater than 0 ( $p < 0.001$ , both by 1-sample t-test). The data indicate that signal content changed abruptly at the border, implying that GPe and GPi neurons at the border were classified correctly as to their structural membership. No SE is shown for the rightmost bin because it contained only one neuron.

Supplementary Figure 2. Summaries of population firing rates. (A) Average spike density

functions of GPe (orange) and GPi (blue) neurons. Little modulation is seen because the increasing and decreasing types of modulations cancel each other out.

(B) Average spike density functions of GPe neurons separated into the two valence categories: modulations that either increased (solid lines) or decreased (dashed line) relative to baseline. There were no striking differences between the average increasing and decreasing modulations. (C) Same as panel B, but for GPi neurons. For GPi, we found only one neuron with visual activity, so the visual category is blank (N/A, not applicable), and only one neuron with increasing delay activity, so there is no solid line in the delay category.

Supplementary Figure 3. Breadths of tuning curves for the increasing type of SNr neurons. Our SNr sample had no increasing saccade-related neurons, so that column is absent. Other conventions are the same as in Fig. 11.

Supplementary Figure 4. Breadths of tuning curves for the decreasing type of SNr neurons. Conventions are the same as in Fig. 12.