

## Supplemental Figure S1

Summary of the experimental timeline. The top and bottom panels correspond to monkeys G and I, respectively. In each panel, tick marks indicate the dates of recording sessions – video recordings of behavior in the home cage (*top of the top row*) and recordings of extracellular neural activity used in the current study (*bottom of the top row*). The rate of occurrence of freezing-like behaviors, reaction times, and movement durations are shown in respective rows second from top to bottom and plotted as means for each month data were collected. *Shading*:  $\pm$  SD for reaction time and movement duration. In reaction time and movement duration panels *horizontal green lines*: mean values across pre-MPTP sessions. *Vertical magenta lines*: times of MPTP administration via intra-carotid (*solid lines*) and IM (*dashed lines*) routes. Additional details on MPTP administration are provided below the timeline.

## Supplemental Figure S2

Tyrosine hydroxylase (TH)-positive cells were depleted preferentially from the right substantia nigra (SN) following MPTP administration. *A*. Immunohistochemical labeling for TH in the healthy control animal L revealed dense populations of TH-positive somata in both the SN and ventral tegmental area (VTA). *B*. Density maps of TH-positive somata in the SN and VTA demonstrate a marked depletion from the right SN of animal G (middle) and I (bottom), with no such depletion observed in the healthy control animal L (top). *C*. Summary of the number and density of TH-positive somata identified in the SN and VTA. TH-positive neurons were depleted markedly yet selectively from the right SN (bold text in far-right column) in both MPTP-treated animals.

## Supplemental Figure S3

MPTP administration reduced use of the contralateral limbs and whole-body rotations toward the more affected side of the body. *A*. The rate of left limb use relative to right limb use during grooming behaviors before (green) and after (magenta) MPTP administration, shown separately for monkey G and I (left and right panels, respectively). *B*. The rate of clockwise whole-body

rotations relative to that of counterclockwise rotations. Statistical comparisons were performed using the Wilcoxon rank-sum test (\*\* $p < 0.01$ ).

### Supplemental Figure S4

Effects of MPTP on response magnitude and duration as quantified from go-cue aligned SDFs. Results from this analysis were closely similar to those in measures taken from movement-aligned SDFs (Fig. 4D-E; following the same conventions). Results from 3-way ANOVA (MPTP  $\times$  response type  $\times$  animal) are shown below. *A*: The reduction in response magnitude was more severe in decrease-type responses (\*\*  $p < 0.01$ , Tukey's test). *B*: Response durations were prolonged following MPTP administration, and that prolongation was more prominent for monophasic responses (\*\*  $p < 0.01$ , Tukey's test).

### Supplemental Figure S5

The increased prevalence of cue-locked responses following MPTP (i.e., Fig. 5D) was found in both increase- (*left*) and decrease-type response populations (*right*). Results from chi-square analysis are shown below figure panels (\*  $p < 0.05$ , \*\*  $p < 0.01$ , adjusted residual analysis). *Open circles*: monkey G. *Open triangles*: monkey I

### Supplemental Figure S6

Effects of MPTP on jitter-corrected response metrics (dispersion, magnitude and duration; i.e., Fig. 6A-C) were similar in cue-locked (panels *A-C*) and movement-locked (panels *D-F*) response subtypes. Results from 3-way ANOVA (MPTP  $\times$  response type  $\times$  animal) are shown below.

## Supplemental Figure S7

Effects of MPTP on Z-scored, jitter-corrected response metrics. *A*: The magnitude of increase-type responses was larger post-MPTP whereas the magnitude of decrease-type responses was diminished (\*  $p < 0.05$ , \*\*  $p < 0.01$ , Tukey's test). *B*: Response durations were prolonged following MPTP administration (\*\*  $p < 0.01$ , Tukey's test). Results from 3-way ANOVA (MPTP  $\times$  response type  $\times$  animal) are shown below.