**Figure S1.** **Frequency distributions for the detected peak times for all ROIs for SCN each slice.** A, raw peak times for each slice with ChR2-Neg slices in red and VIP-ChR2 slices in blue. Green line represents the starting cutoff for inclusion (see Methods). Subsequent black lines represent 24 h intervals beginning at the starting cutoff used for peak number assignment in B. B, the peak number assignments from the ROI peak times shown in A. Based on the 24 h intervals beginning with the starting cutoff (green line), peaks occurring within each successive interval were assigned to the specified peak number.

**Figure S2.** **Individual relative phase maps for each SCN slice used in the ex vivo analyses.** A, relative phase maps for the ChR2-Neg group. B, relative phase maps for the VIP-ChR2 group. In all maps, the relative phase is calculated as the difference, in hours of each ROI relative to the mean phase of the slice at that peak. Warmer colors represent delayed phase, cooler colors represent advanced phase.

**Figure S3.** **Left–right differences in the SCN are equivalent between groups.** *k*-means clustering of the left and right halves of the SCN from each slice of the ChR2-Neg (A) and VIP-ChR2 (B) groups. C, Left–right differences in median absolute deviation for each slice by cycle.

**Figure S4.** **Individual actograms for each mouse used in the in vivo analyses.** Actograms are double-plotted with 6-minute binning. Yellow region represents 8 h window of daily light exposure. Stimulation window (blue shading) was 8 h following lights off on the final 7 days of light exposure. Animals were attached to fiber optic implants on the second day of the records.

**Figure S5.** Entrained phase of the locomotor behavior rhythm for each mouse estimated excluding the first 24 h of DD (A) and using all 7 days of DD (B). The free-running period calculated excluding the first 24 h of DD.

**Figure S6.** Double-plotted median half-hourly-counts (A, C, E) and associated acrophase estimation (B, D, E) for each group in each day of Baseline (A, B), Stimulation (C, D), and DD (E, F). Yellow shading indicates light, blue shading indicates LED stimulation of the SCN. Dark blue represents the stimulation window on non-stimulation days (Baseline, DD), dark yellow represents the light window on DD days. Indicated *p* values are calculated by circular ANOVA. Dashed lines represent double-plotted data.