SUPPLEMENTAL FIGURE LEGENDS

Figure S1. White noise stimulus distribution in red-green-blue (RGB) phosphor color space, cone-contrast space, and cone-opponent space. Light intensities in phosphor space were normally distributed with a mean identical to the background and a standard deviation of 15% of the available range. **A–C.** Scatterplot of 10,000 randomly drawn intensity values (background subtracted). Transformed phosphor intensities in L-, M- and S-cone-contrast space (**D–F**) and in cone-opponent space (**G–I**).

Figure S2. Gabor, Difference of Gaussians (DoG) and elliptical DoG model fits to the spatial weighting functions of six example cells in **Figure 3**. **A–B.** Simple cells **C–D.** $DO_{\text{LM-opponent}}$ cells **E–F.** $DO_{\text{S-cone sensitive}}$ cells.

Figure S3: Comparison of non-concentric DoG and DoG model fits. Cross-validated R is plotted from non-concentric DoG fits and from DoG fits for simple (**A**), $DO_{\text{LM-opponent}}$ (**B**), and $DO_{\text{S-cone sensitive}}$ cells (**C**).

Figure S4: RF area is plotted against eccentricity for simple (**A**), $DO_{\text{LM-opponent}}$ (**B**), and $DO_{\text{S-cone sensitive}}$ cells (**C**). The area of each RF was quantified as the area of an ellipse defined by the envelope of the fitted Gabor function ($\pi\sigma^2/\gamma$), cut off at 1 standard deviation.

Figure S5. Reclassification of cells with reversed cone weight criteria. Shown are the normalized cone weights of simple (black), $DO_{\text{LM-opponent}}$ (red), $DO_{\text{S-cone sensitive}}$ (blue) and unclassified (gray) cells. Under these criteria, cells were classified as simple if the L- and M-cone weights had the same sign, that together, accounted for 80% of the total cone weight and individually accounted for at least 20%. Cells were labeled as $DO_{\text{LM-opponent}}$ if the L- and M-cone weights had opposite sign, together accounted for 80% and individually accounted for at least 10% of the total cone weight. Classification of $DO_{\text{S-cone sensitive}}$ cells was unchanged from the description in the Methods.

Figure S6. Model comparisons and spatial opponency analyses after reclassification of cells as illustrated in **Figure S5**. **A.** Cross-validated R is plotted from Gabor fits and from DoG fits for simple cells. **B.** Identical to **A** but for $DO_{LM\text{-}opponent}$ cells. **C.** Analysis of best fitting phase (ϕ) of Gabor fits to all simple RFs (white) and those that are better fit by the Gabor model than the DoG model (black). **D.** Identical to **C** but for $DO_{LM\text{-}opponent}$ RFs. **E.** Analyses of best fitting aspect ratio (γ) of Gabor fits to all simple RFs (white) and those that are better fit by the Gabor model than the DoG model (black). The median γ is plotted for all simple cell RFs (open triangle) and also for cells better fit by Gabor model (closed triangle). **F.** Identical to **E** but for DO RFs. **G.** Cross-validated R is plotted from Gabor fits and from non-concentric DoG fits for simple cells. **H.** Identical to **G** but for $DO_{LM\text{-}opponent}$ cells. **I.** Histogram of spatial opponency indices (SOIs) for simple cells based on spatial weighting functions. **J.** Identical to **I** but for $DO_{LM\text{-}opponent}$ cells.

Figure S7. Reclassification of cells with relaxed cone weight criteria. Shown are the normalized cone weights of simple (black) and DO (red) cells. Under these criteria, cells were classified as simple if the L-, M-cone and S-cone weights had the same sign ,i.e., cone non-opponent. Cells were labeled as DO if at least one cone weight had an opposite sign relative to another cone weight ,i.e., cone opponent. The magnitude of cone weights were not considered for classification and DO cells were not divided into further subtypes.

Figure S8. Model comparisons and spatial opponency analyses after reclassification of cells as illustrated in **Figure S7**. **A.** Cross-validated R is plotted from Gabor fits and from DoG fits for simple cells. **B.** Identical to **A** but for DO cells. **C.** Analysis of best fitting phase (ϕ) of Gabor fits to all simple RFs (white) and those that are better fit by the Gabor model than the DoG model (black). **D.** Identical to **C** but for DO RFs. **E.** Analyses of best fitting aspect ratio (γ) of Gabor fits to all simple RFs (white) and those that are better fit by the Gabor model than the DoG model (black). The median γ is plotted for all

simple cell RFs (open triangle) and also for cells better fit by Gabor model (closed triangle). **F.** Identical to **E** but for DO RFs. **G.** Cross-validated R is plotted from Gabor fits and from non-concentric DoG fits for simple cells. **H.** Identical to **G** but for DO cells. **I.** Histogram of spatial opponency indices (SOIs) for simple cells based on spatial weighting functions. **J.** Identical to **I** but for $DO_{LM\text{-}opponent}$ cells.

Figure S9. Comparison of Gabor and DoG model fits using three different analyses. **A.** Cross-validated prediction of spike-triggered stimuli using the area under receiver operating characteristics (ROC AUC) is plotted from Gabor fits and from DoG fits for simple cells. **B.** Identical to **A.** but for $DO_{LM\text{-}opponent}$ cells. **C.** Identical to **A.** but for $DO_{S\text{-}cone\ sensitive}$ cells. **D.** Cross-validated sum of squared errors (SSE) is plotted from Gabor fits and from DoG fits for simple cells. **E.** Identical to **D.** but for $DO_{LM\text{-}opponent}$ cells. **F.** Identical to **D.** but for $DO_{S\text{-}cone\ sensitive}$ cells. **G.** Bayesian Information Criterion (BIC) is plotted from Gabor fits and from DoG fits for simple cells. A better model fit yields a lower BIC. **H.** Identical to **G.** but for $DO_{LM\text{-}opponent}$ cells. **I.** Identical to **G.** but for $DO_{S\text{-}cone\ sensitive}$ cells.

Figure S10. Comparison of Gabor and non-concentric DoG model fits using three different analyses. **A.** Cross-validated prediction of spike-triggered stimuli using the area under receiver operating characteristics (ROC AUC) is plotted from Gabor fits and from non-concentric DoG fits for simple cells. **B.** Identical to **A.** but for $DO_{LM\text{-}opponent}$ cells. **C.** Identical to **A.** but for $DO_{S\text{-}cone\ sensitive}$ cells. **D.** Cross-validated sum of squared errors (SSE) is plotted from Gabor fits and from non-concentric DoG fits for simple cells. **E.** Identical to **D.** but for $DO_{LM\text{-}opponent}$ cells. **F.** Identical to **D.** but for $DO_{S\text{-}cone\ sensitive}$ cells. **G.** Bayesian Information Criterion (BIC) is plotted from Gabor fits and from non-concentric DoG fits for simple cells. A better model fit yields a lower BIC. **H.** Identical to **G.** but for $DO_{LM\text{-}opponent}$ cells. **I.** Identical to **G.** but for $DO_{S\text{-}cone\ sensitive}$ cells.