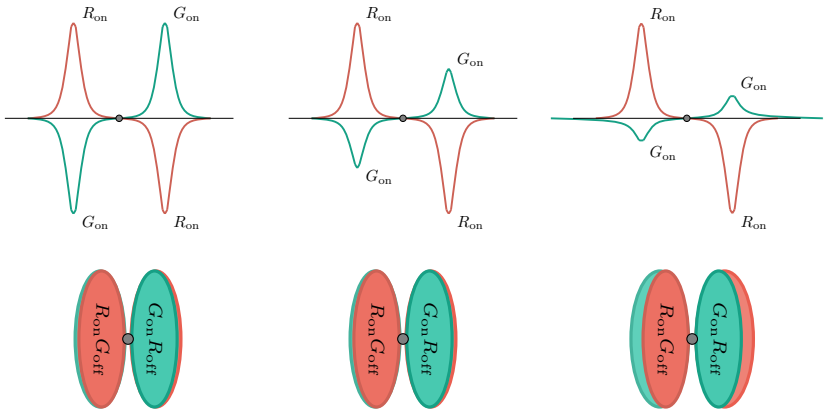
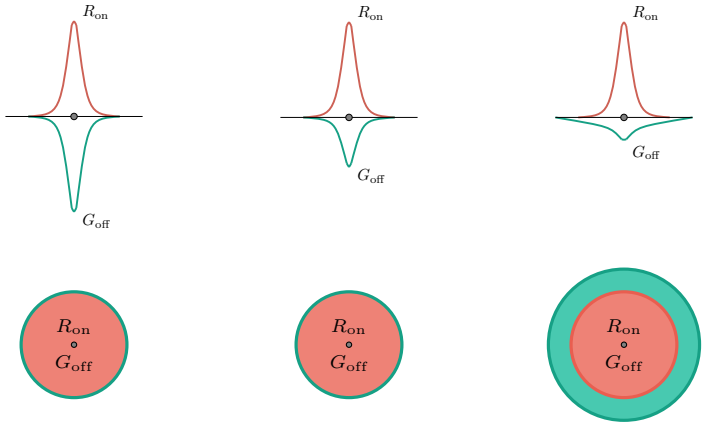



(a) Symmetric balanced double-opponent receptive field

(b) Symmetric imbalanced double-opponent receptive field

(c) Center/ surround double-opponent receptive field

Figure 1: Examples of various possible double-opponent receptive field configurations, many others could be designed. All function to describe color properties of borders, though their response patterns to similar stimuli vary slightly.

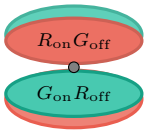



(a) Symmetric balanced single-opponent receptive field

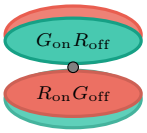
(b) Symmetric imbalanced single-opponent receptive field

(c) Classic center/surround single-opponent receptive field

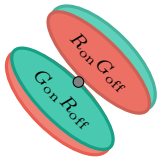
Figure 2: Examples of various possible single-opponent receptive field configurations, many others could be designed. All function to describe color properties of surfaces, though their response patterns to similar stimuli vary slightly.




(a) Vertical $R$ vs. $G$ double-opponent cell receptive fields.

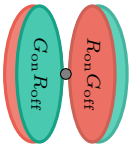



(b) Vertical $G$ vs. $R$ double-opponent cell receptive fields.

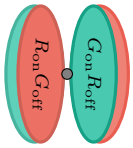



(c) Diagonal $R$ vs. $G$ double-opponent cell receptive fields.


(d) Diagonal $G$ vs. $R$ double-opponent cell receptive fields.




(e) Horizontal $R$ vs. $G$ double-opponent cell receptive fields.

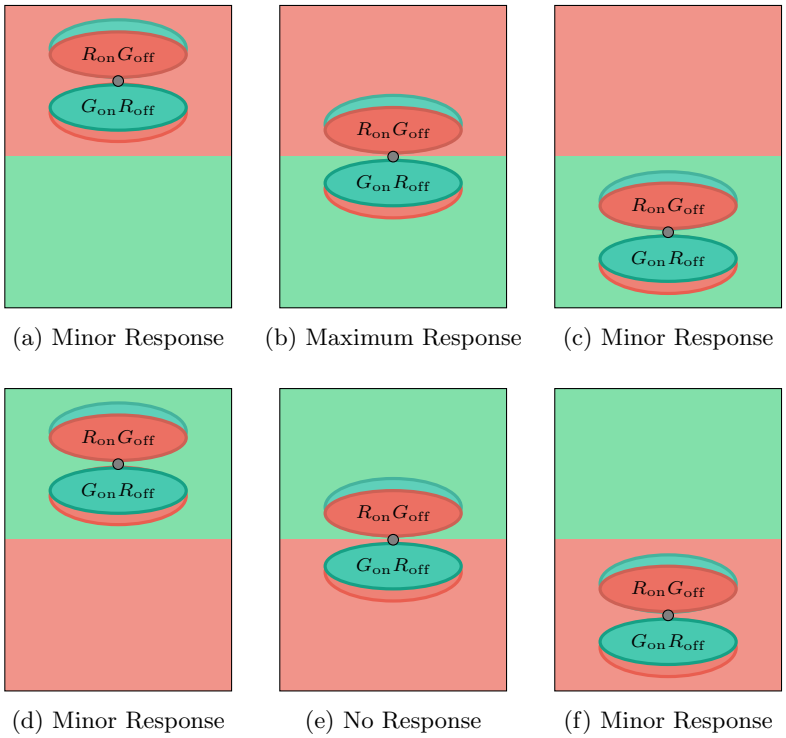



(f) Horizontal $G$ vs. $R$ double-opponent cell receptive fields.


(g) Diagonal $R$ vs. $G$ double-opponent cell receptive fields.


(h) Diagonal $R$ vs. $G$ double-opponent cell receptive fields.

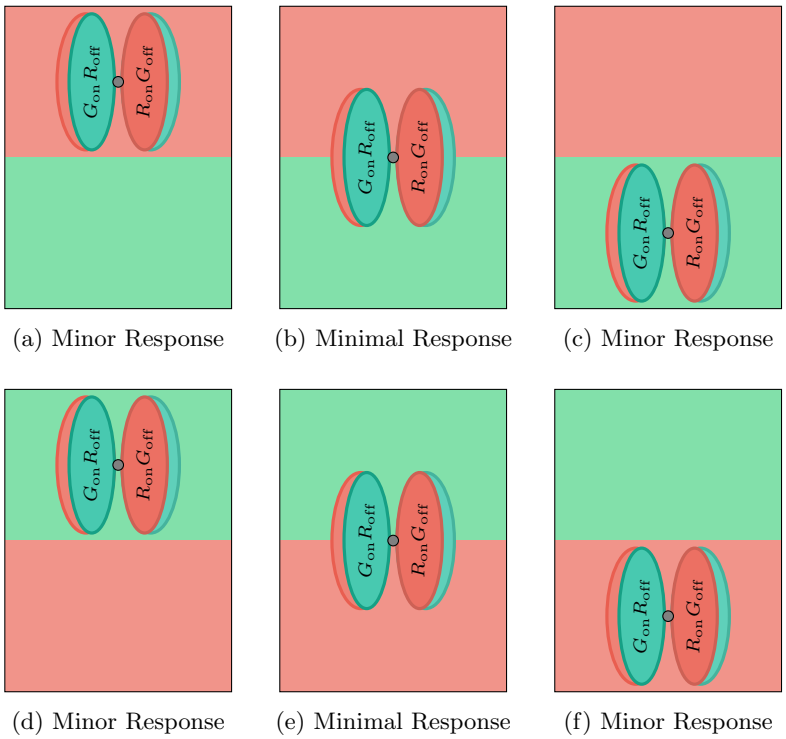
Figure 3: Schematic of orientation selectivity in double-opponent receptive field configurations. Any single double-opponent neuron only has one receptive field hard wired into it. By having collections of neurons, each selective to a different orientation at the same retinotopic location, we obtain a degree of rotation invariance.




(a) Minor Response (b) Maximum Response (c) Minor Response

(d) Minor Response (e) No Response (f) Minor Response

Figure 4: A double-opponent cell selective to horizontally oriented borders with red above and green below; only responsive to that particular stimulus. In Figure (b), the neuron is presented with its ideal stimulus: its $R_{\text{on}}$ and $G_{\text{on}}$ receptive fields are fully activated while its $R_{\text{off}}$ and $G_{\text{off}}$ receptive fields are completely unactivated. Figure (e) presents the neuron with the exact opposite stimulus, neither its $R_{\text{on}}$ nor $G_{\text{on}}$ receptive fields are activate at all, and both its $R_{\text{off}}$ and $G_{\text{off}}$ receptive fields are fully activated, ensuring no response possible from the cell. While its $R_{\text{on}}$ receptive field might be strongly stimulated in (a) and (f), it's $R_{\text{off}}$ receptive field cancels it out. Similarly, in (c) and (d) its $G_{\text{on}}$ receptive field is stimulated but cancelled out by activity in its $G_{\text{off}}$ receptive field.




(a) Minor Response (b) Minimal Response (c) Minor Response

(d) Minor Response (e) Minimal Response (f) Minor Response

Figure 5: A double-opponent cell selective to vertically oriented borders with red to the right and green on the left; completely unresponsive to a horizontal border. While its $R_{\text{on}}$ receptive field might be strongly stimulated in (a) and (f), it's $R_{\text{off}}$ receptive field cancels it out. Similarly, in (c) and (d) its $G_{\text{on}}$ receptive field is stimulated but cancelled out by activity in its $G_{\text{off}}$ receptive field. In (b) and (e) both of its $R_{\text{on}}$ and $G_{\text{on}}$ receptive fields are moderately activated, but again, cancelled out by activation in its $R_{\text{off}}$ and $G_{\text{off}}$ receptive fields, respectively.