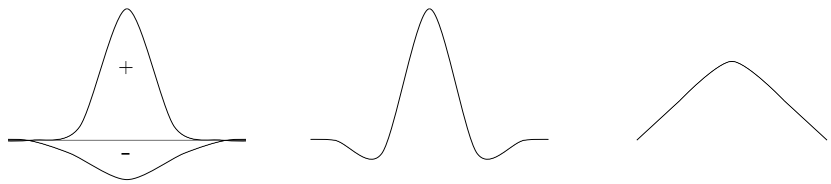


(a)
Opponent Receptive Field Model

(b)
Classical Difference of Gaussians (DoG)

(c)
Discrete Wavelet Tranformation Filter

Figure 1: **//TODO** *DoG and DWT are edge detectors, they should be compared to DO cells.*

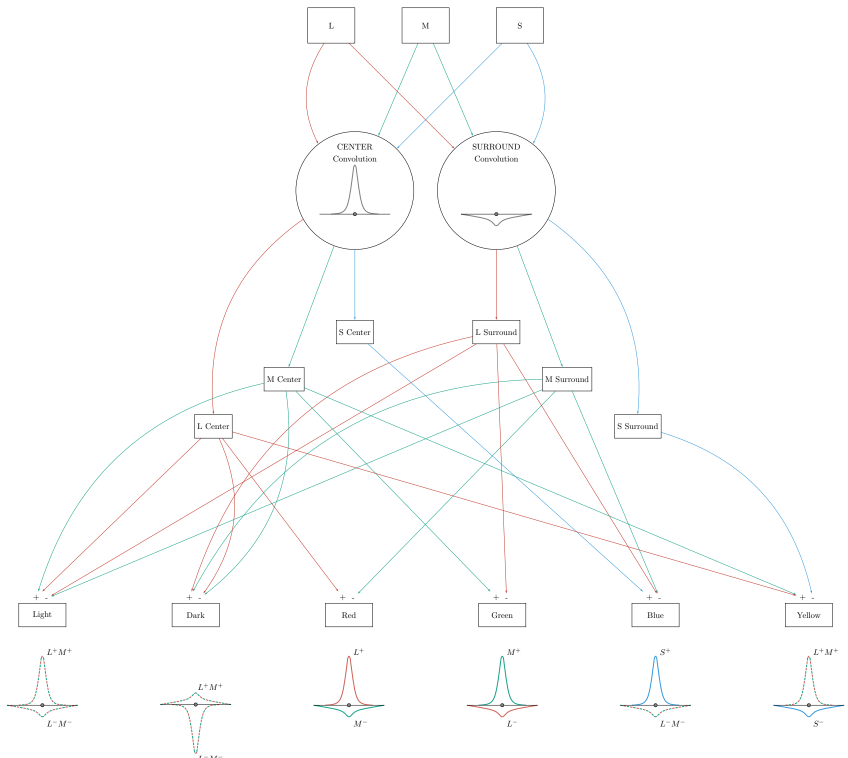
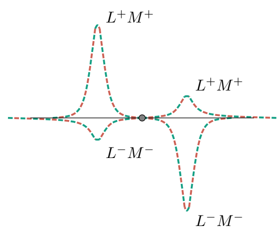
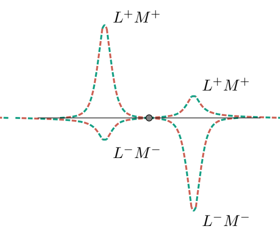


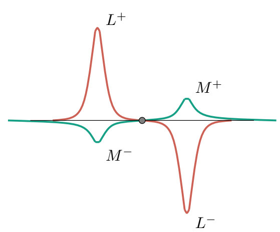
Figure 2: Diagram of *Opponent Processing of Receptive Fields* workflow. The L, M, and S channels are convoluted with center and surround gaussians and then combined to build opponent colors, here exemplified by single-opponent cell receptive fields.



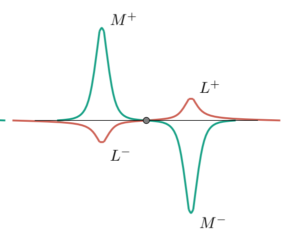
(a) Light DO Receptive Field



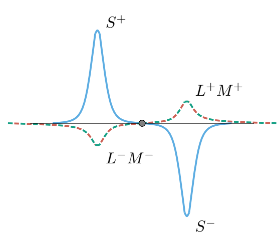
(b) Dark DO Receptive Field



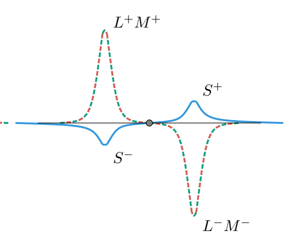
(c) Red DO Receptive Field



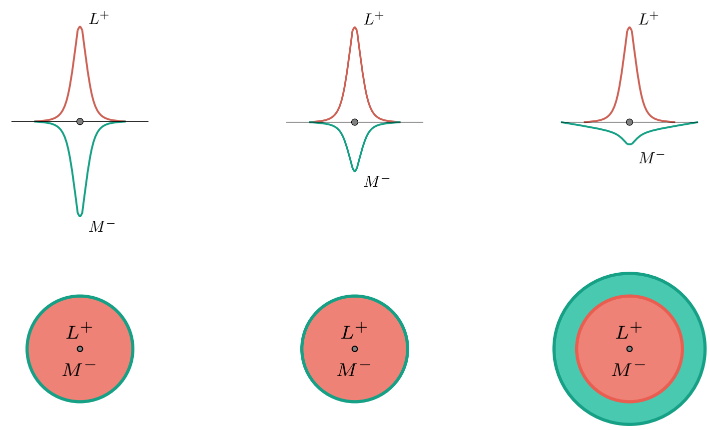
(d) Green DO Receptive Field



(e) Blue DO Receptive Field



(f) Yellow DO Receptive Field

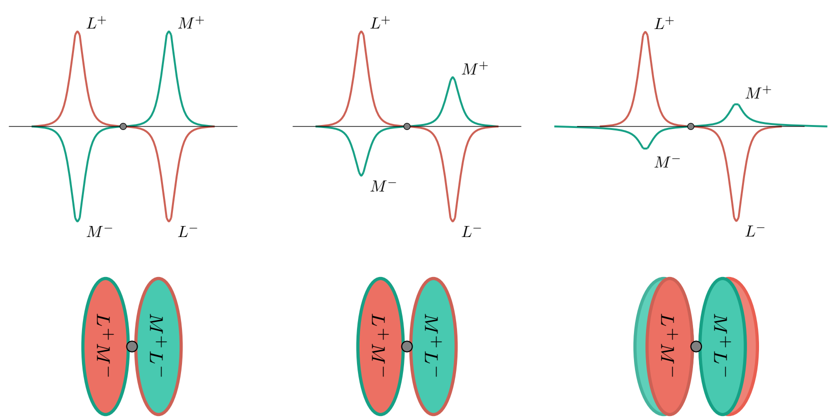


(a) Symmetric balanced single-opponent receptive field

(b) Symmetric imbalanced single-opponent receptive field

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

Figure 4: 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.

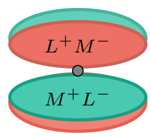


(a) Symmetric balanced double-opponent receptive field

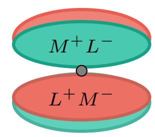
(b) Symmetric imbalanced double-opponent receptive field

(c) Center/ surround double-opponent receptive field

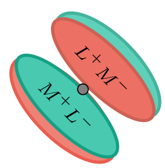
Figure 5: Examples of various possible double-opponent receptive field configurations, many others could be designed. All function to describe color properties of borders, though their response patterns to similar stimuli vary slightly.



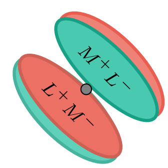
(a) Vertical R vs. G double-opponent cell receptive fields.



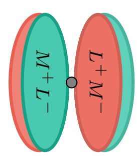
(b) Vertical G vs. R double-opponent cell receptive fields.



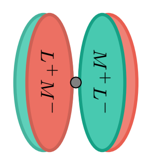
(c) Diagonal R vs. G double-opponent cell receptive fields.



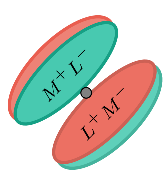
(d) Diagonal G vs. R double-opponent cell receptive fields.



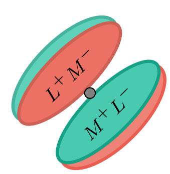
(e) Horizontal R vs. G double-opponent cell receptive fields.



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

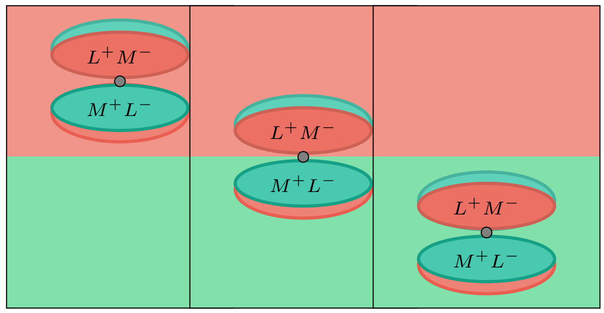


(g) Diagonal R vs. G double-opponent cell receptive fields.

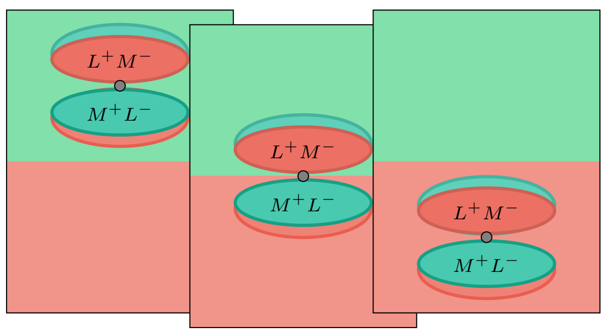


(h) Diagonal R vs. G double-opponent cell receptive fields.

Figure 6: 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.

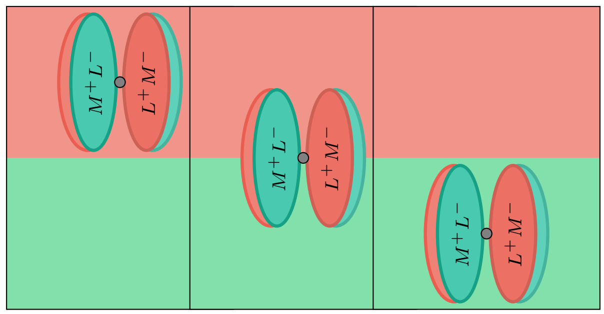


(a) Minor Response (b) Maximum Response (c) Minor Response

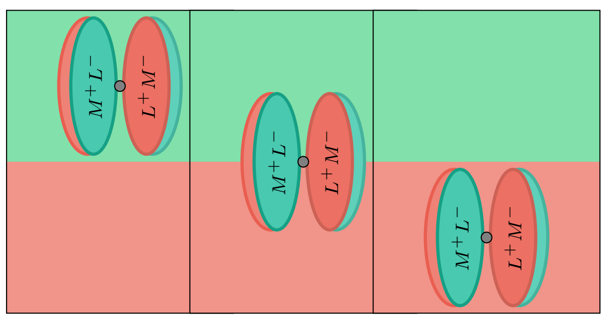


(d) Minor Response (e) No Response (f) Minor Response

Figure 7: 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 L^+ and M^+ receptive fields are fully activated while its L^- and M^- receptive fields are completely unactivated. Figure (e) presents the neuron with the exact opposite stimulus, neither its L^+ nor M^+ receptive fields are activate at all, and both its L^- and M^- receptive fields are fully activated, ensuring no response possible from the cell. While its L^+ receptive field might be strongly stimulated in (a) and (f), it's L^- receptive field cancels it out. Similarly, in (c) and (d) its M^+ receptive field is stimulated but cancelled out by activity in its M^- receptive field.

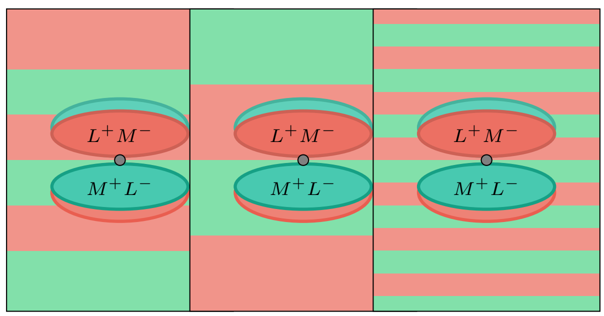


(a) Minor Response (b) Minimal Response (c) Minor Response



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

Figure 8: 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 L^+ receptive field might be strongly stimulated in (a) and (f), it's L^- receptive field cancels it out. Similarly, in (c) and (d) its M^+ receptive field is stimulated but cancelled out by activity in its M^- receptive field. In (b) and (e) both of its L^+ and M^+ receptive fields are moderately activated, but again, cancelled out by activation in its L^- and M^- receptive fields, respectively.



(a) Maximum Response

(b) Maximum Response

(c) Maximum Response

Figure 9: A double opponent cell tuned to a particular spatial frequency. Either a (b) lower or a (c) higher spatial frequency than preferred lowers the response of the cell.