Stereoscopic Systems Part 1

Terminology: Stereoscopic vs. “3D”

“3D Animation” refers to computer animation created with programs (like Maya) that manipulate objects in a 3D space, though the rendered image is in 2D.

To avoid confusion, the term “Stereo 3D” is used.

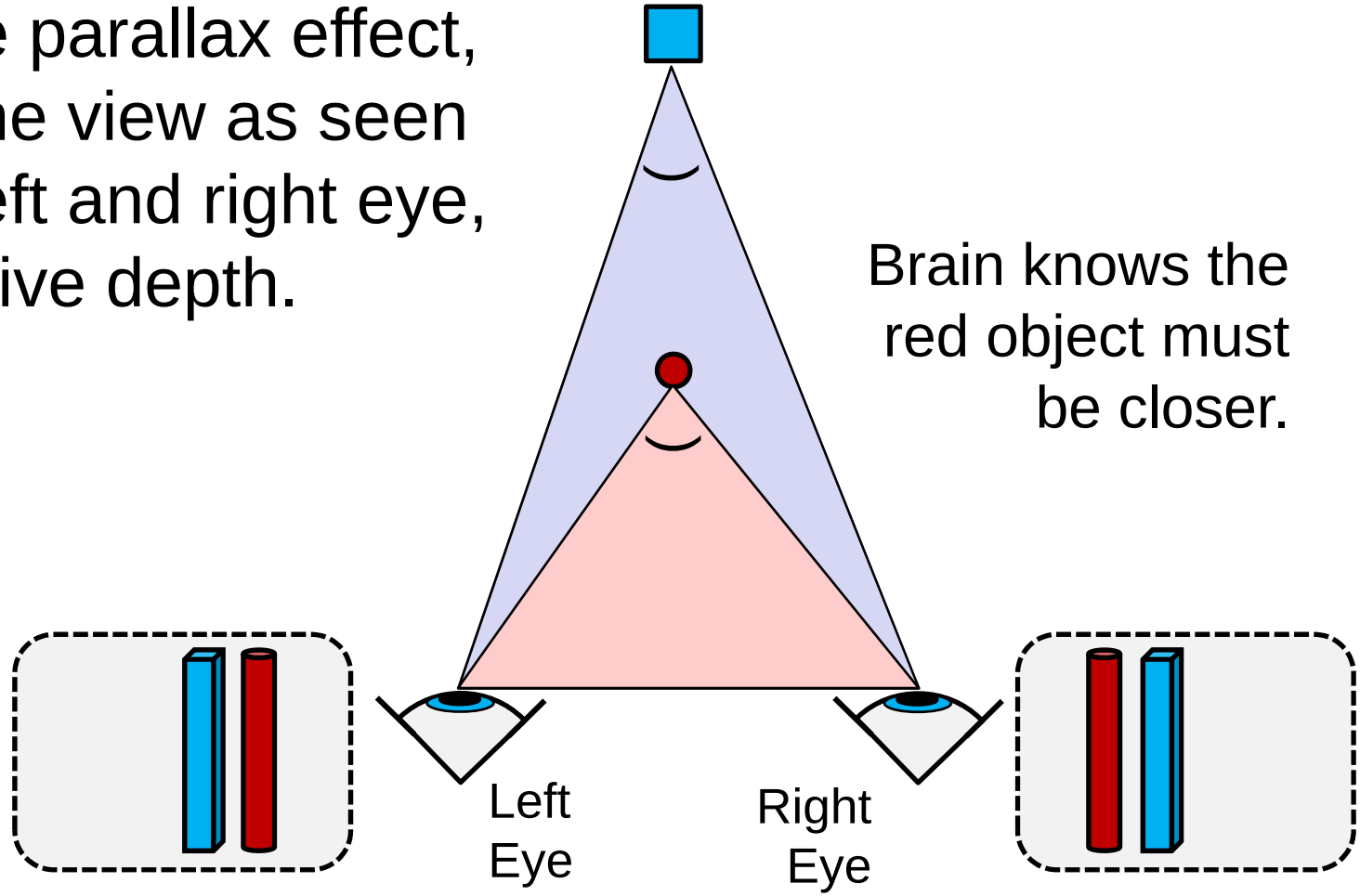
2D Animation

3D Animation

Stereo 3D

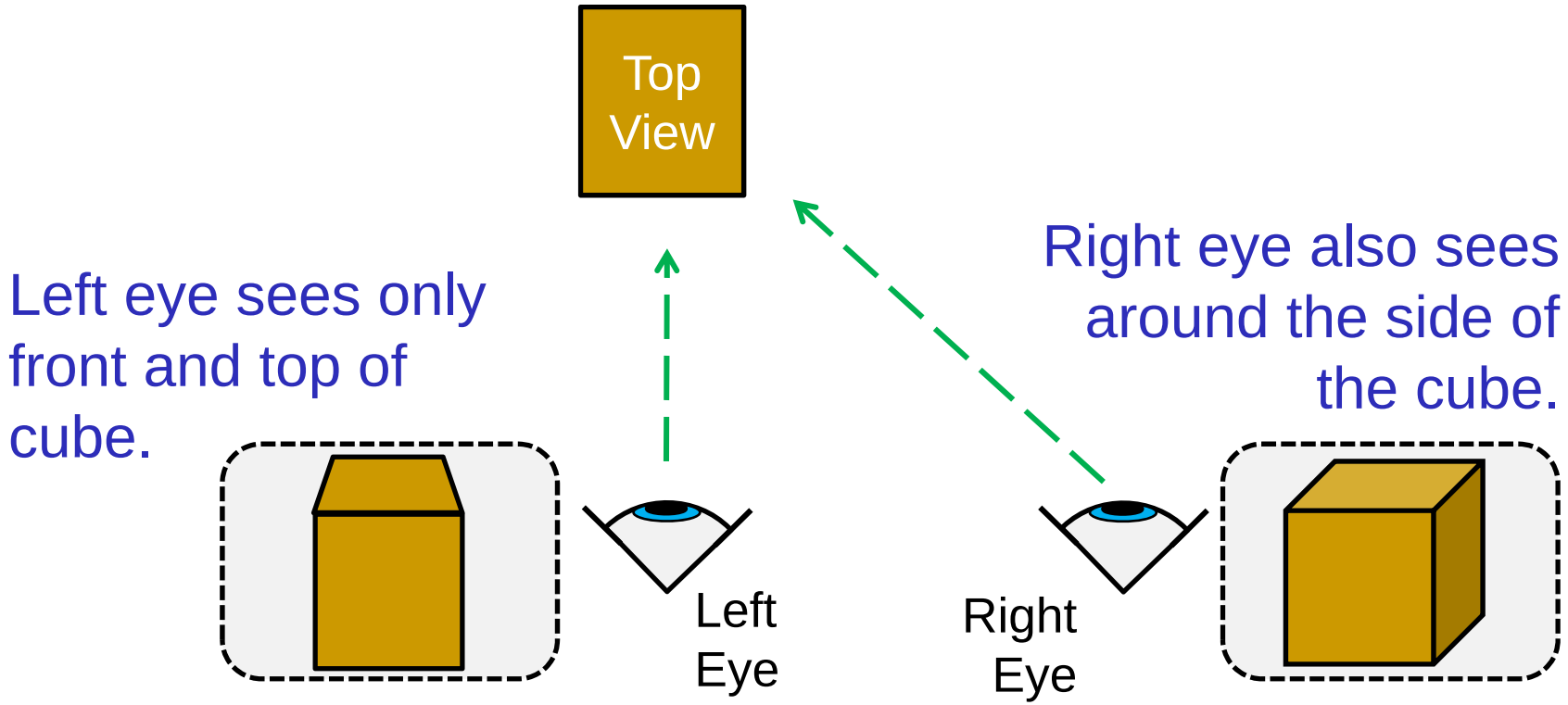
Stereoscopic Vision (Stereopsis)

Stereoscopic vision uses the parallax effect, taking the view as seen by the left and right eye, to perceive depth.



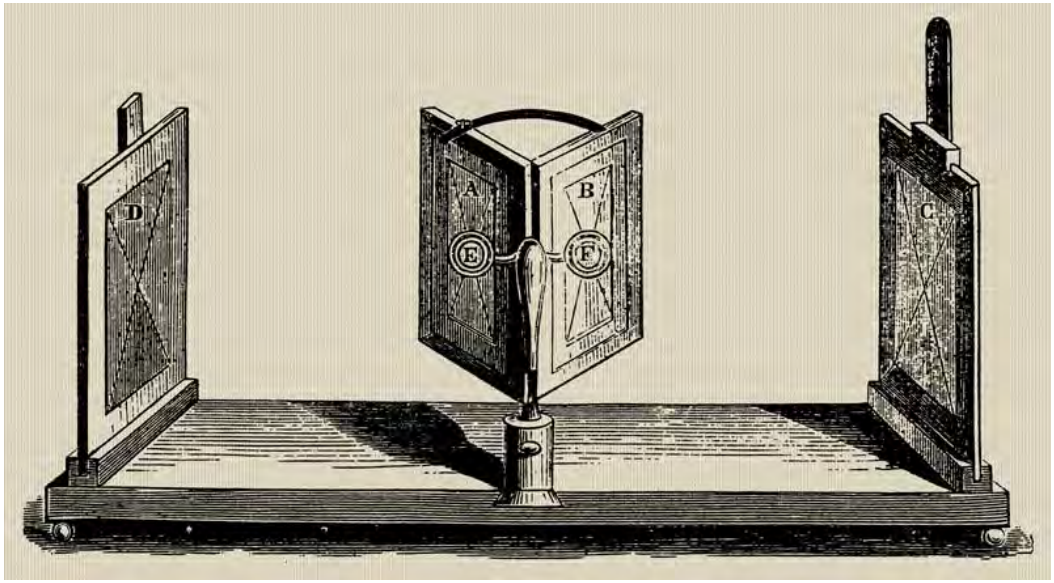
Occlusion Revelation

Occlusion revelation is when one eye sees part of an object that the other eye cannot.

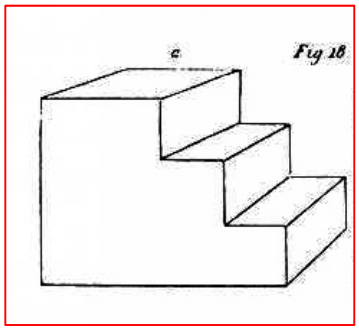


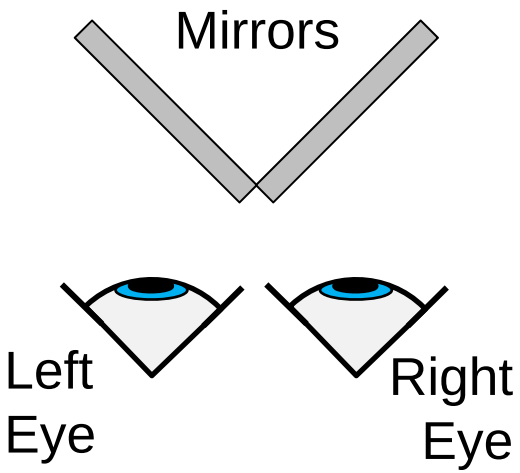
Stereoscope

Charles Wheatstone, in 1838, built a stereoscope to allow a person to see 3D images from a pair of 2D drawings.

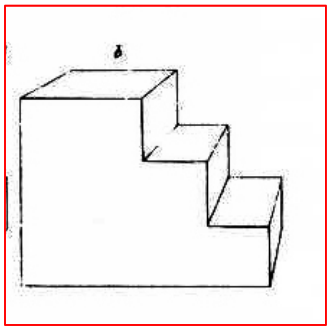


Left Drawing

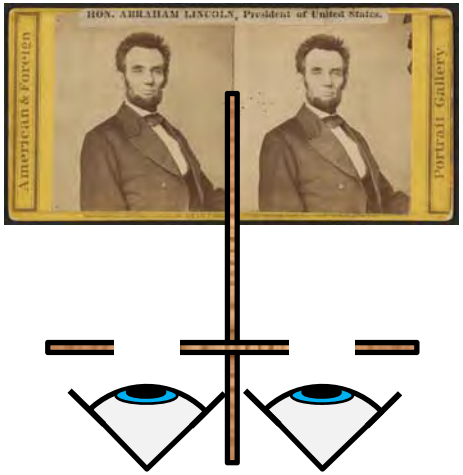




Right Drawing



Stereoscopes

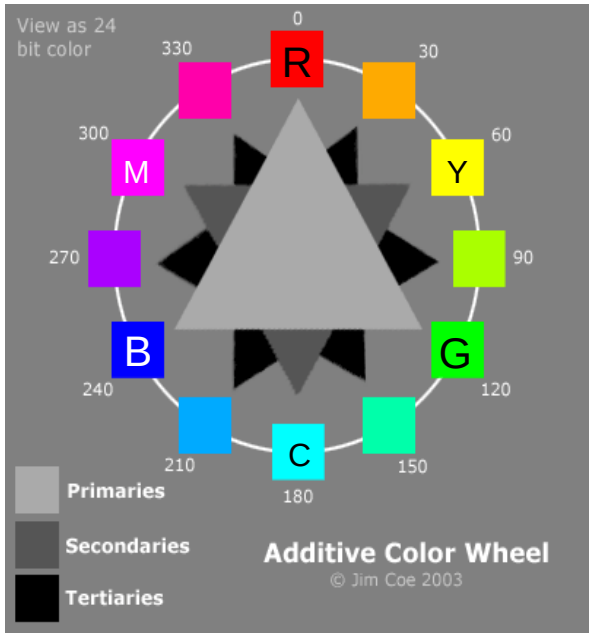


In 1861, Oliver Wendell Holmes, Sr. created a popular, stereoscope design.

View-Master stereoscope was introduced in 1939.

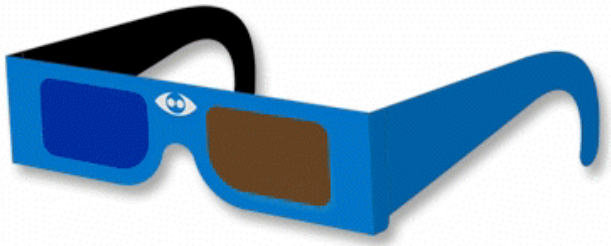
Anaglyph Glasses

A simple way to present a separate view to each eye is to use filters of an additive color complement pair.



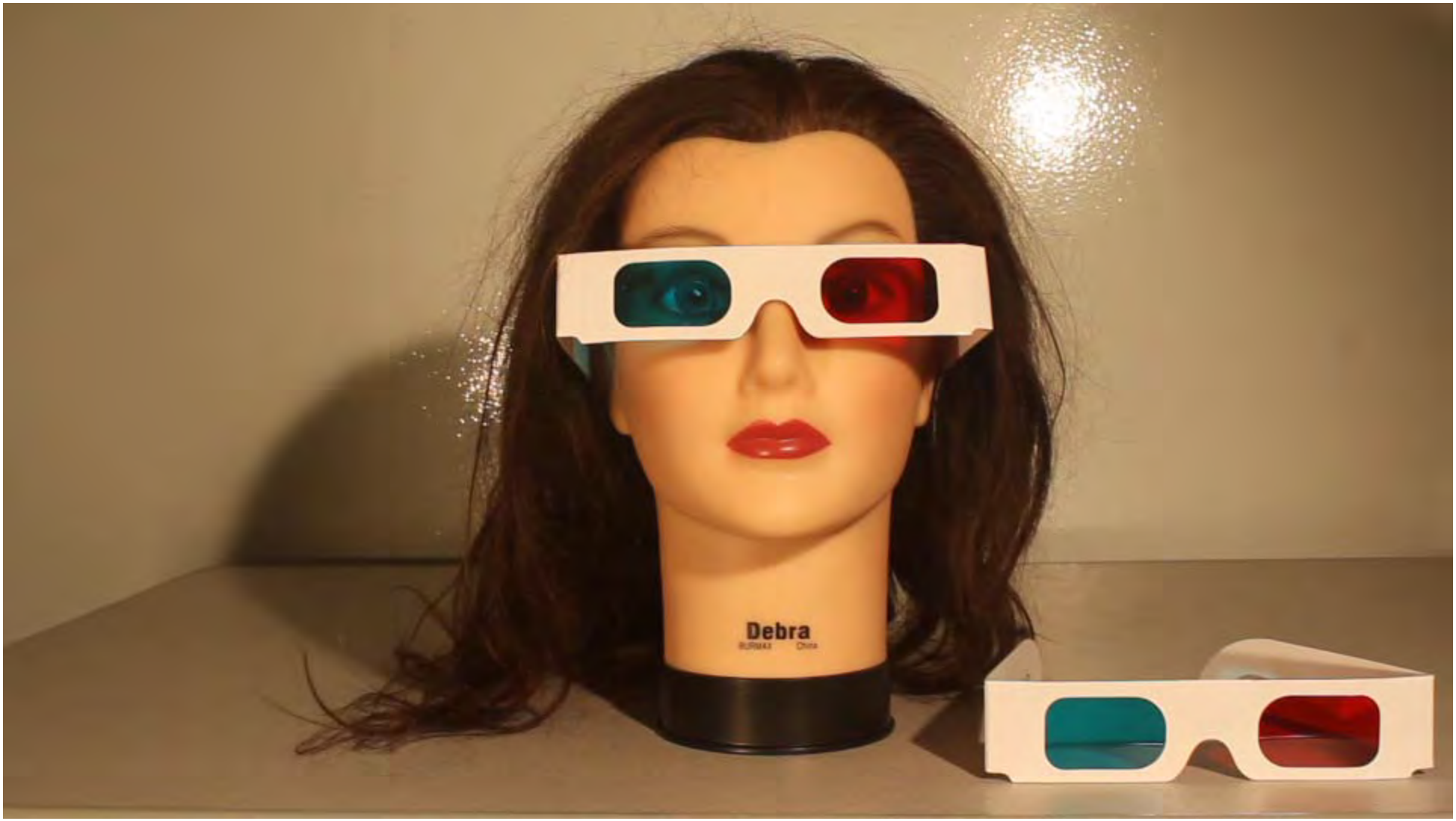
Red/Cyan

Green/Magenta



Blue/Yellow

Anaglyph Glasses



Anaglyph Glasses

Put on a pair of anaglyph glasses, look in a mirror, close one eye and then close the other eye.

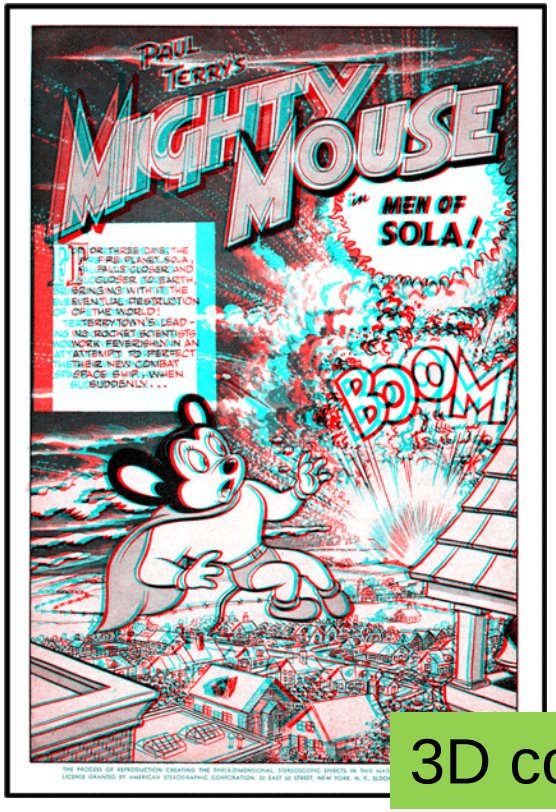
No filter

Red filter

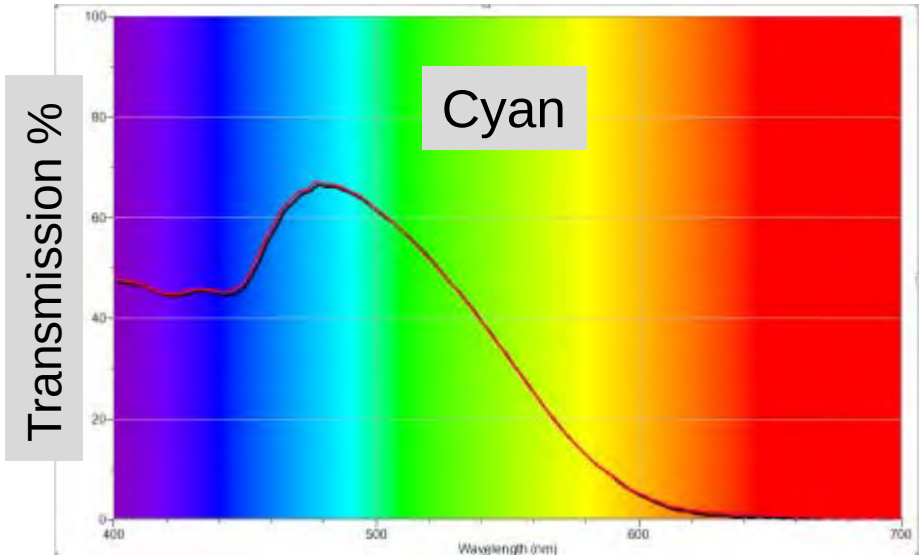
Cyan filter

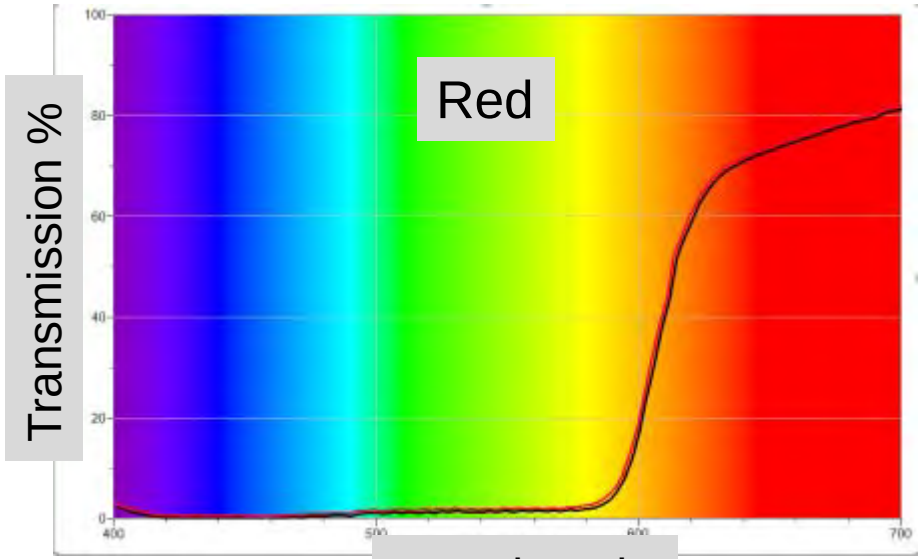
Red/Cyan Anaglyph

Most common type of anaglyph glasses use red/cyan pair of filters.



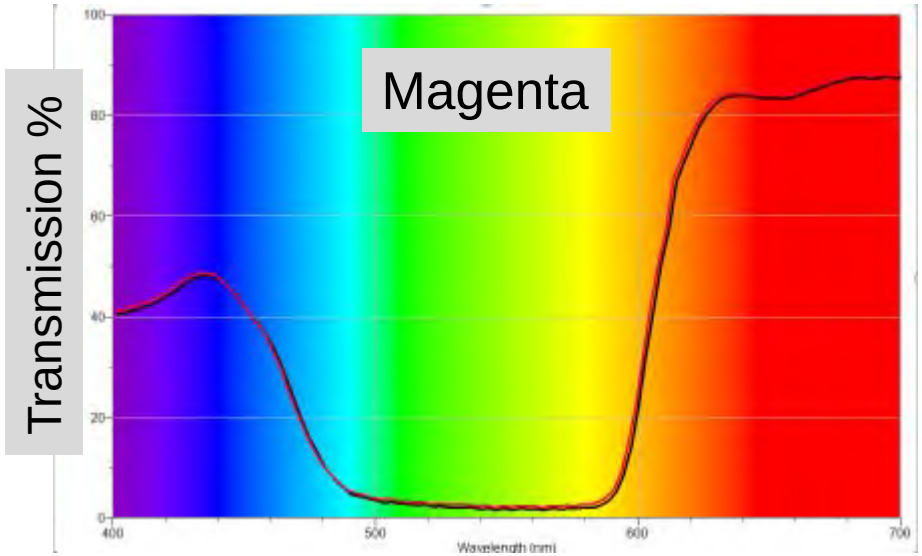
3D comic



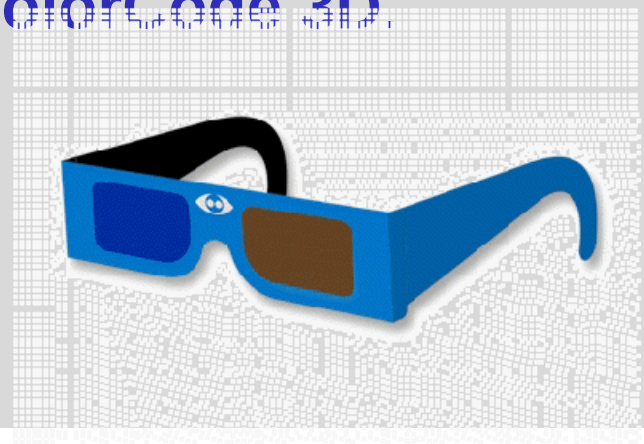


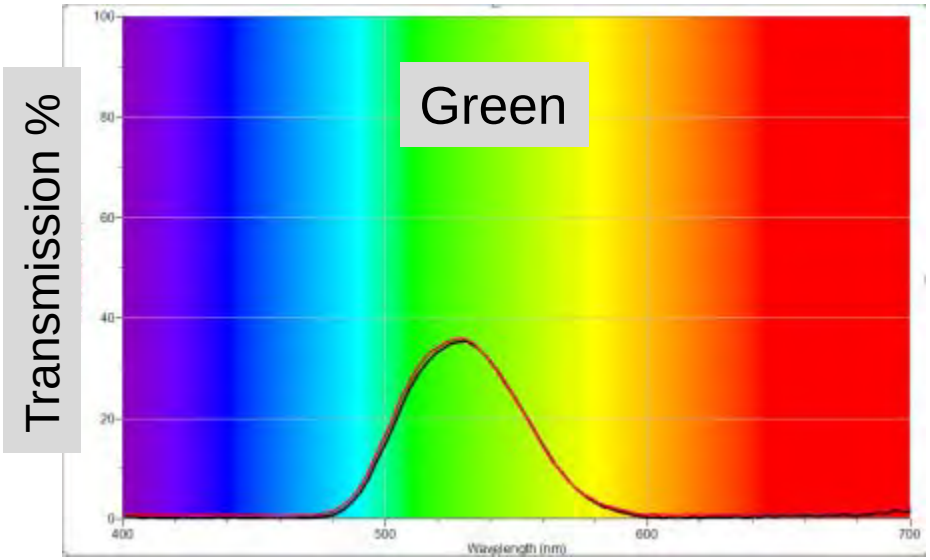
Green/Magenta Filters

The green/magenta combination is better for viewing stereo 3D movies on televisions.



Another option is blue/yellow, called **ColorCode 3D**.





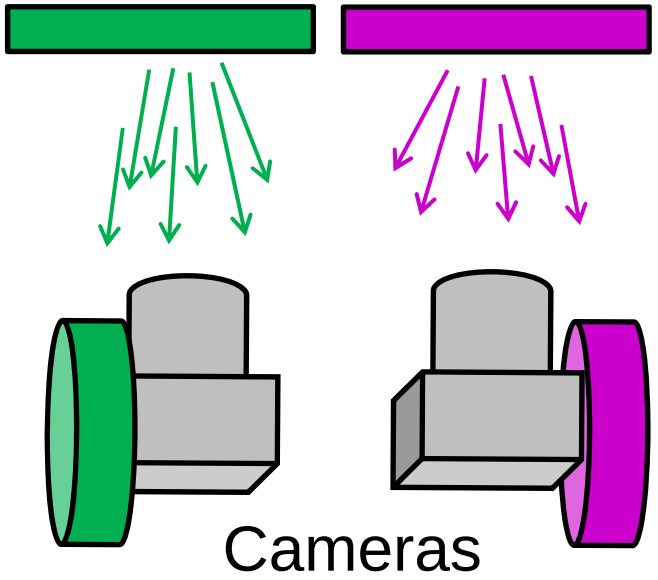
Anaglyph Filming

House of Wax (1953)

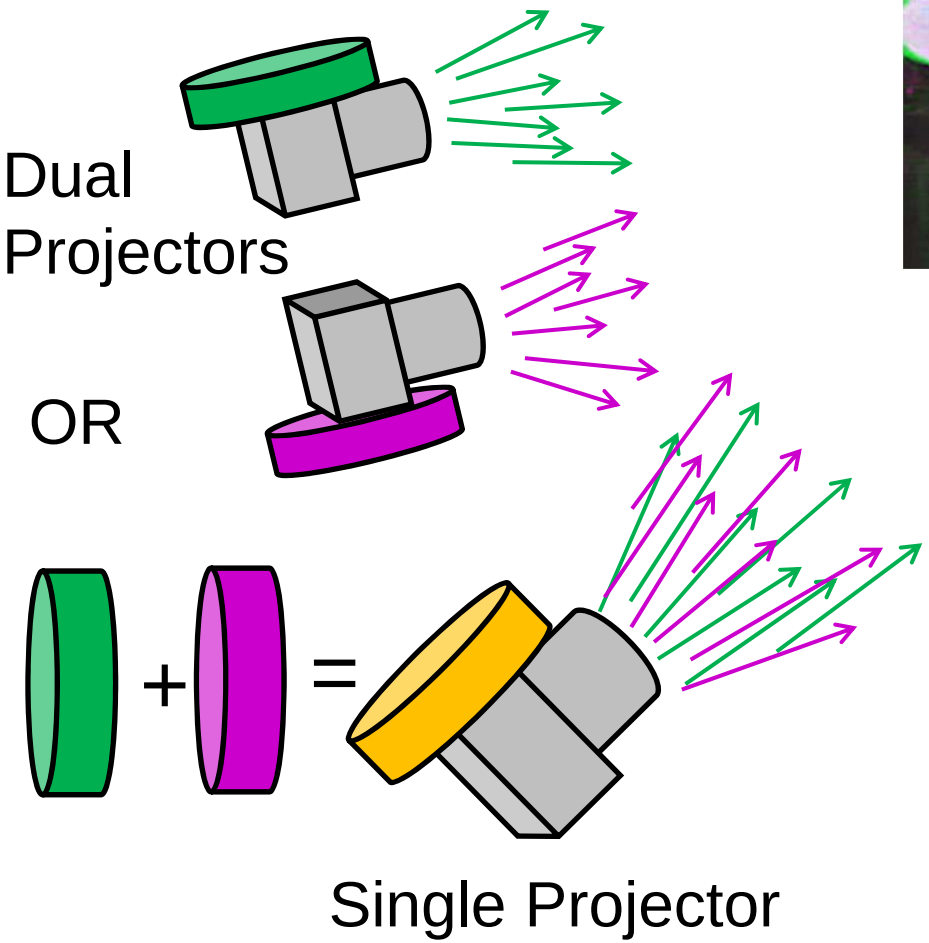
Stereoscopic films use a pair of cameras, one for each view.

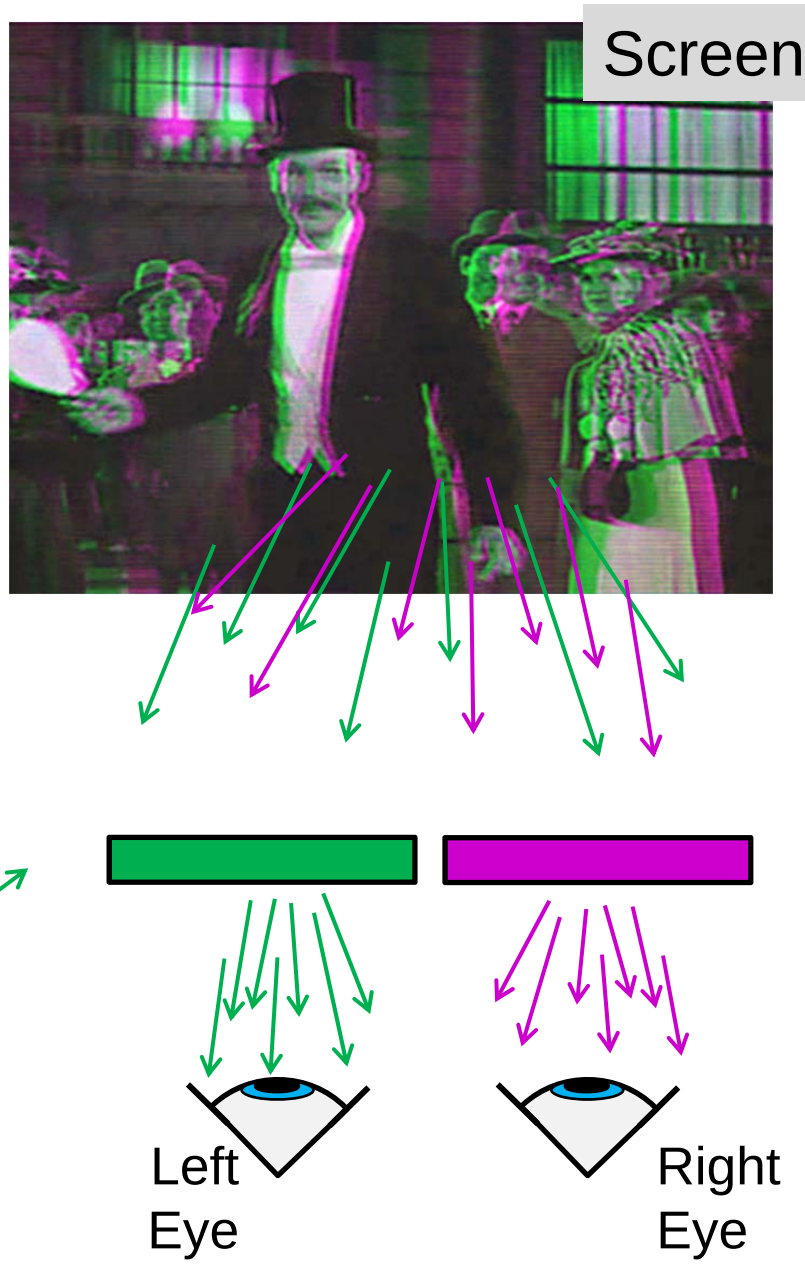
Simple to do with computer animation; more complicated in live-action.

Stereoscopic 3D camera for live-action.



Anaglyph Projection



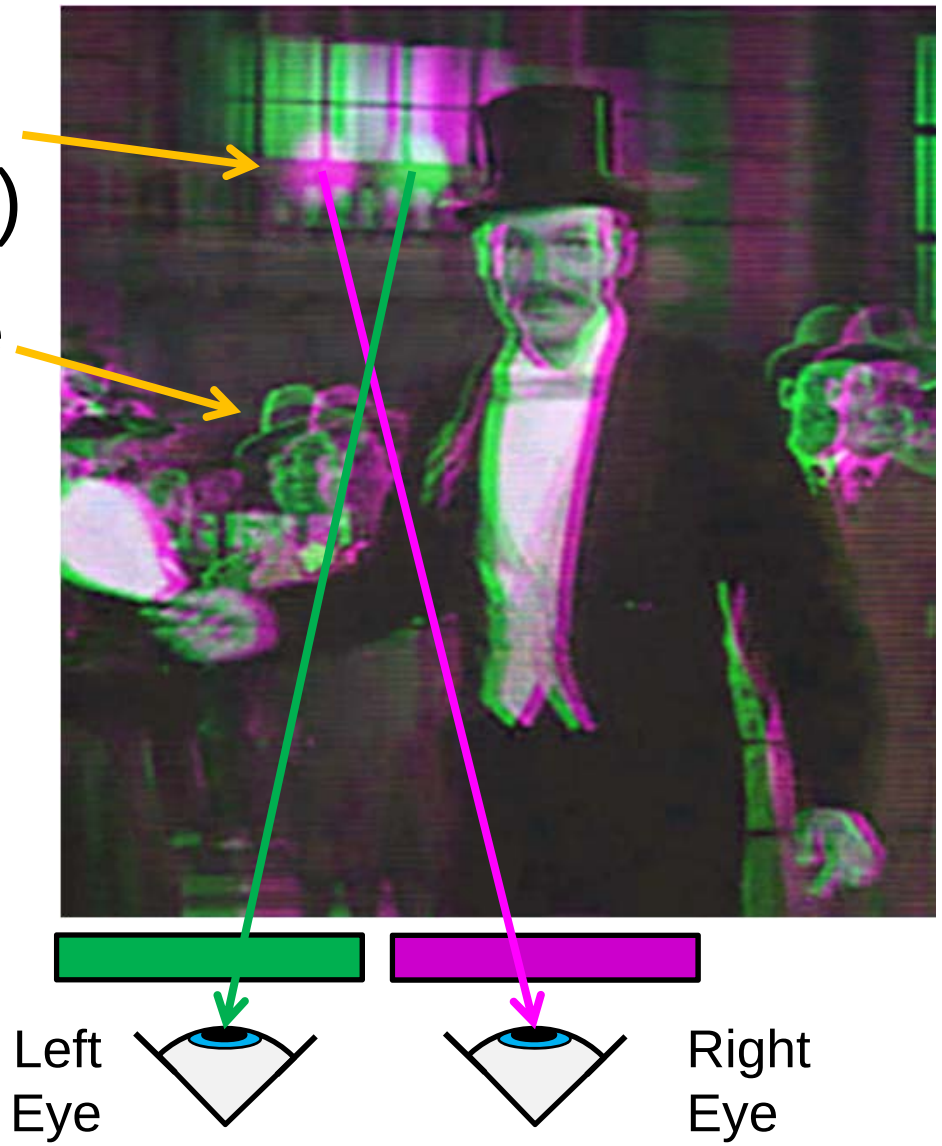


Negative Parallax

Foreground Image
(Negative Parallax)

Background Image
(Positive Parallax)

Objects can appear to come out of the screen and into the theater space by use of negative parallax.



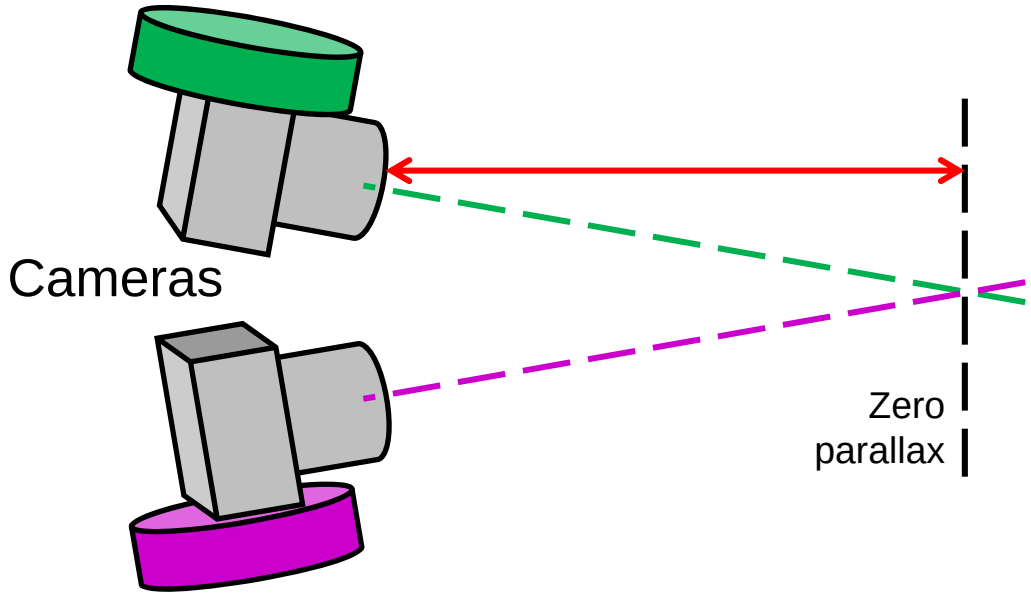
Positive Parallax

Foreground Image
(Negative Parallax)

Background Image
(Positive Parallax)

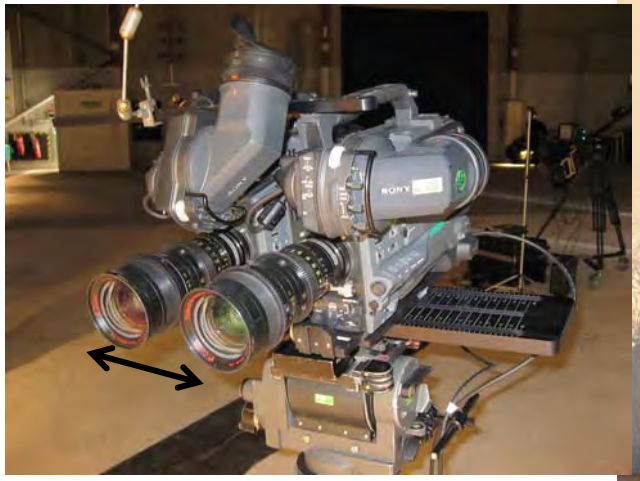
Objects with positive parallax appear to be behind the screen (in screen space).

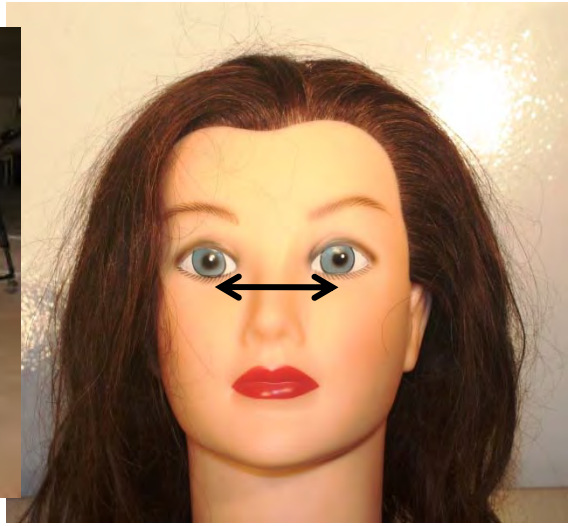
Convergence & Interaxial Distances



Distance from the cameras to zero parallax is the *convergence distance*.

Distance between the cameras is the *interaxial distance*.

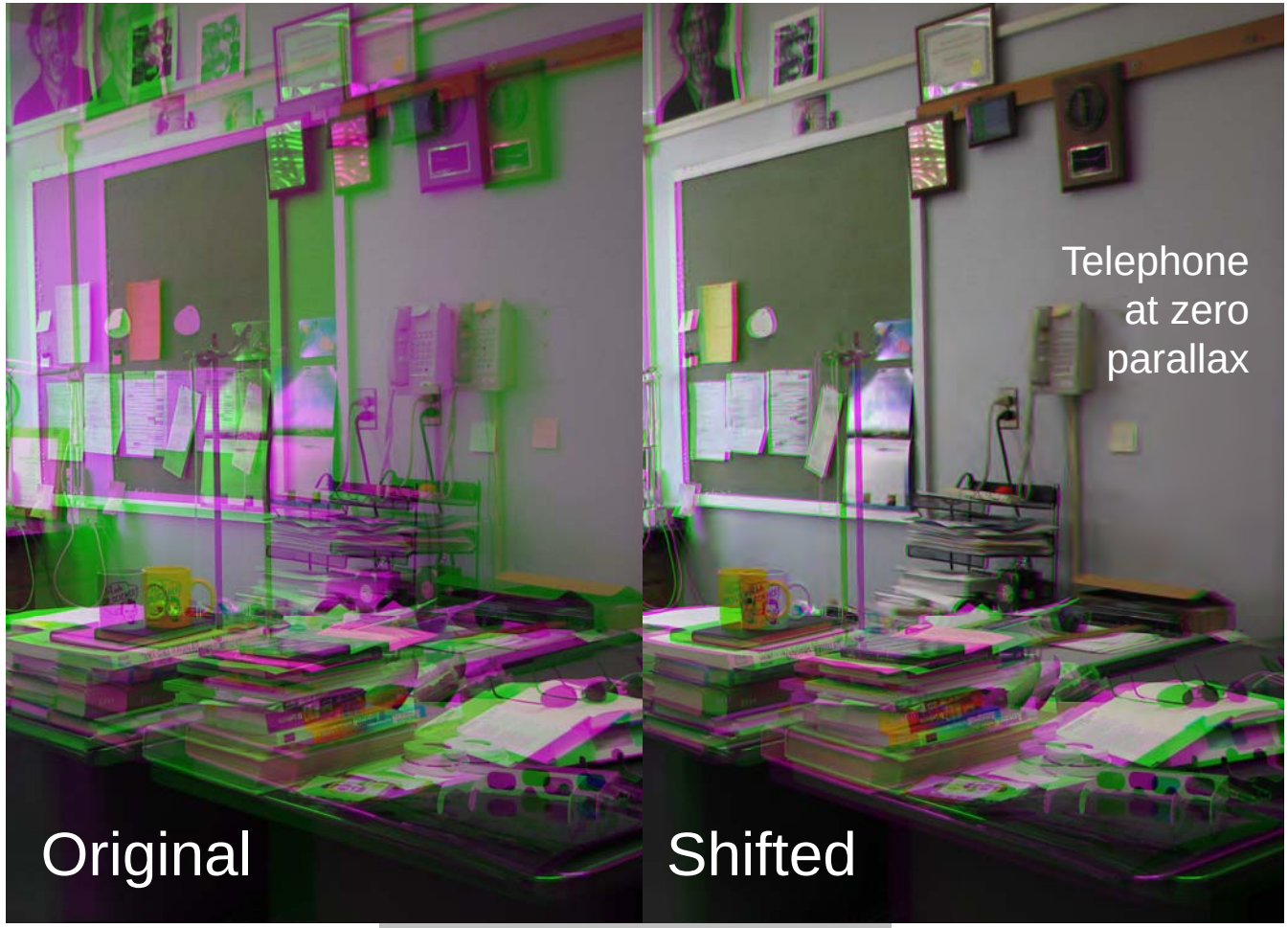




Moving the Convergence Distance

Convergence distance depends on the cameras' toe-in angle.

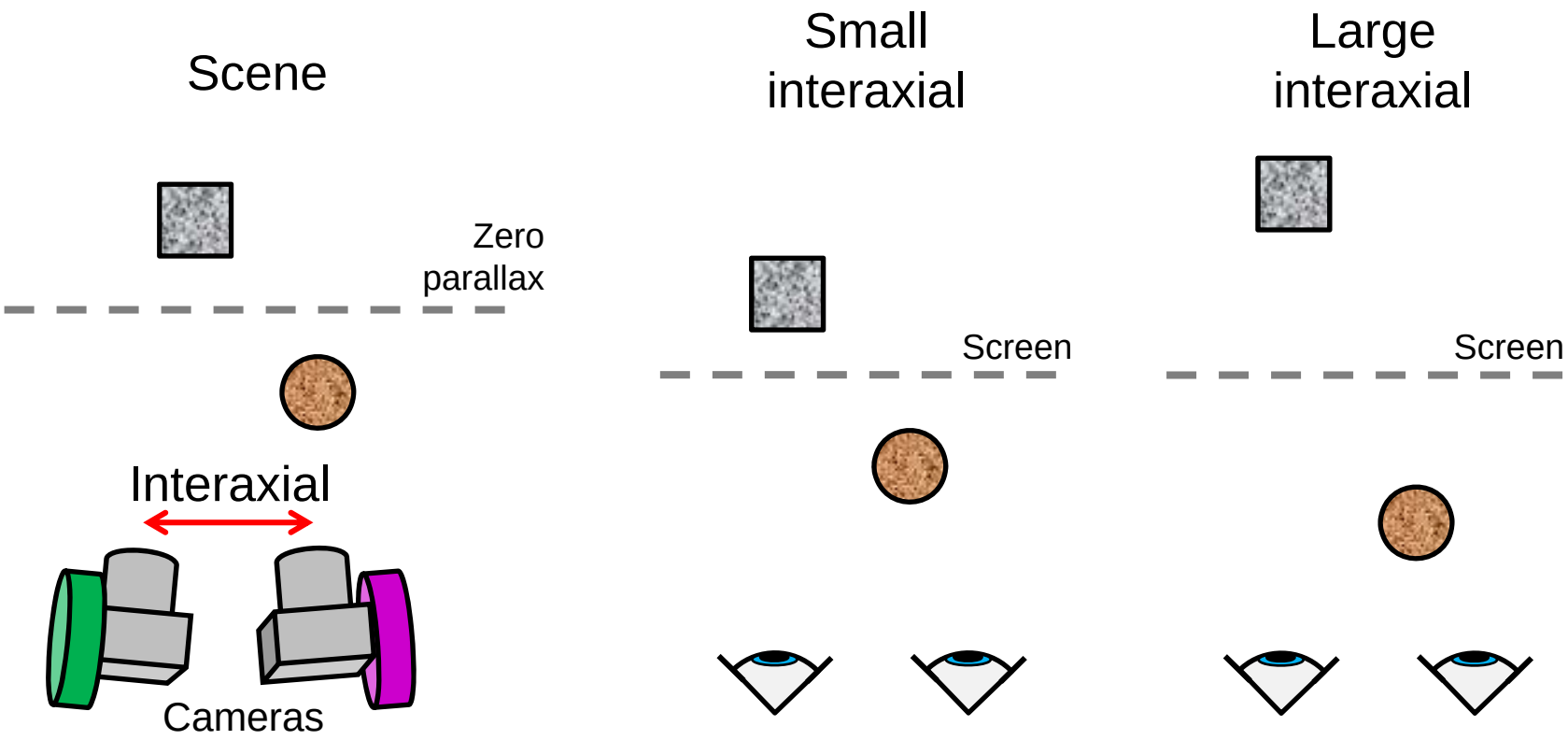
Can adjust convergence distance by horizontally shifting one image relative to the other.



Green/Magenta anaglyph

Interaxial Distance & Depth

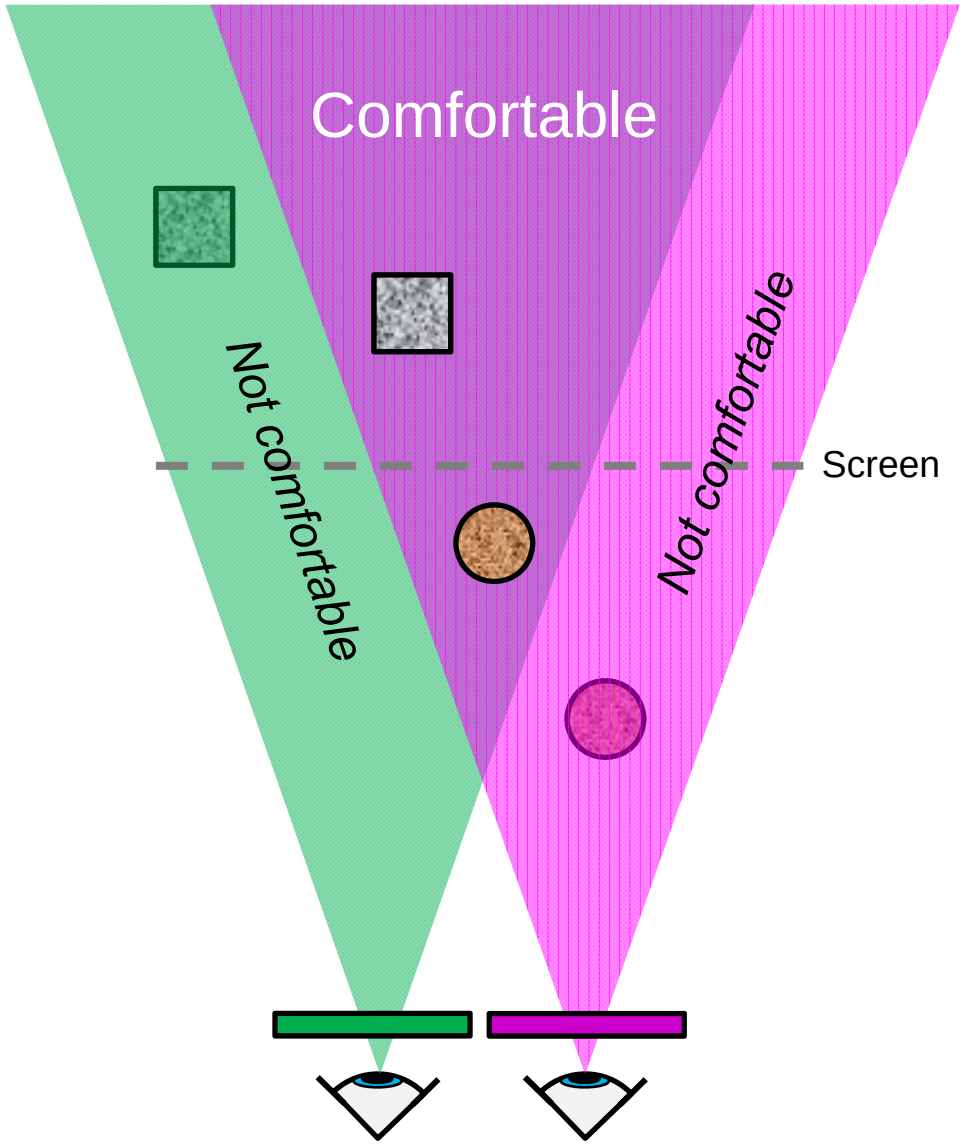
The larger the interaxial distance, the greater the stereoscopic effect.



Retinal Rivalry

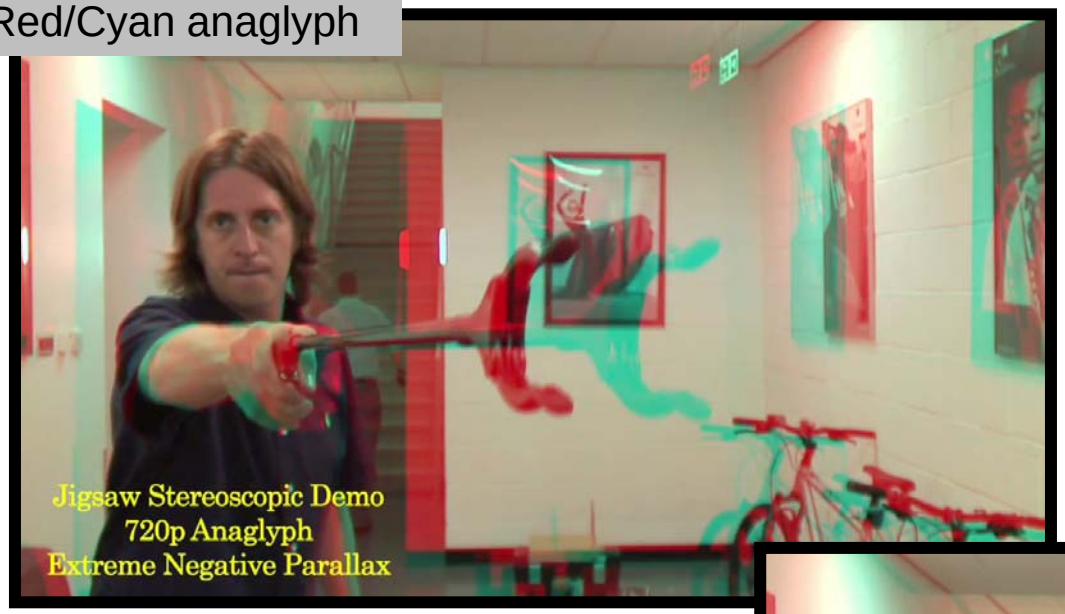
Retinal rivalry is when one of the two images is outside the cone of vision for either eye

The viewer becomes uncomfortable due to the brain's inability to resolve the image.



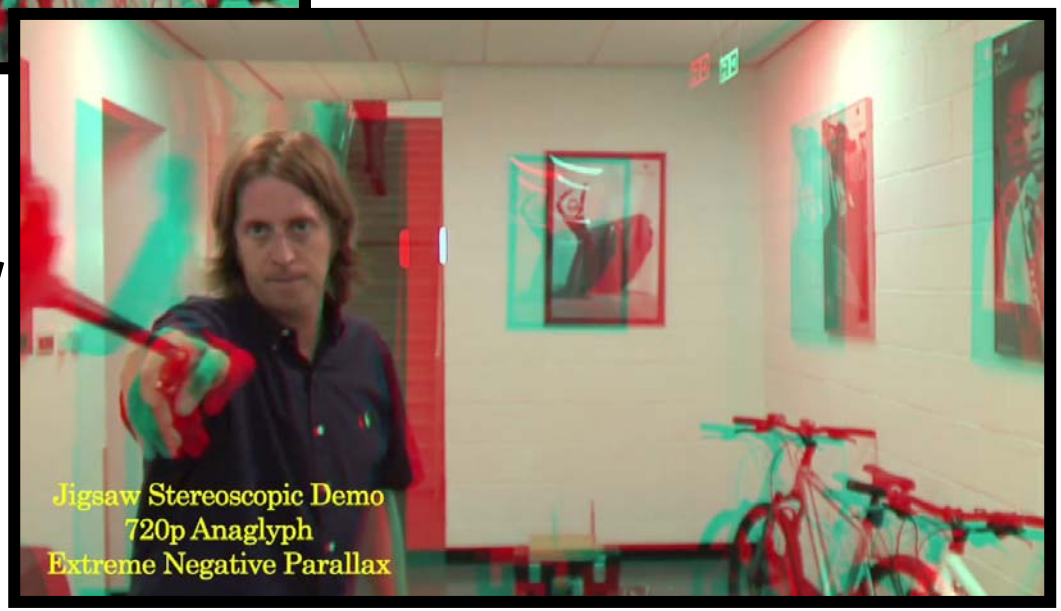
“Breaking the Frame”

Red/Cyan anaglyph



Negative parallax makes the claw appear to come out of the screen.

Depth perception by stereopsis is destroyed when overridden by occlusion.



Summary

- Stereoscopic systems present a different image to each eye, using parallax and occlusion revelation for depth perception.
- Anaglyph systems use colored filters with additive complement colors (e.g., red / cyan).
- An object with negative parallax appears as if it is between the viewer and the screen.
- Convergence distance is the distance from the camera to the screen (zero parallax).
- Interaxial distance is the separation between the cameras and affects the stereo 3D effect.