Understanding the Human Perception System

Lessons learnt from prototyping and research for VR and AR

Hello!

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- Working on Trezi, an immersive collaboration platform for the AEC industry
- 10+ years working with real-time rendering engines

Why understand human perception?

AR

Convince the brain that something is present in real world

VR

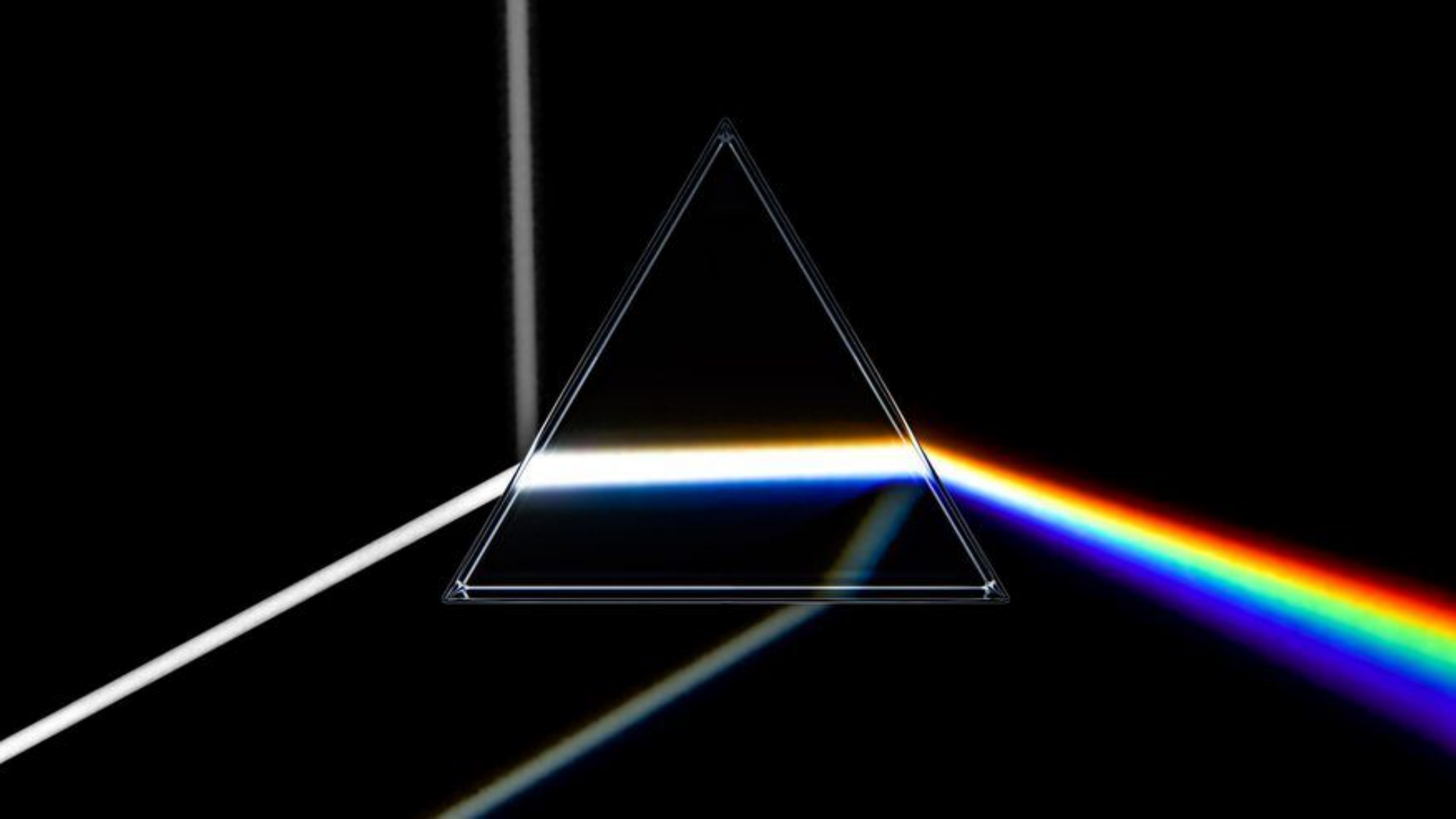
Convince the brain that you are present somewhere else

The human brain

- Very sensitive to small details
- But also gets tricked by simple things
- Understanding perception is the key for believable VR / AR content
- Focus on the vision part for now as it is the most important part

Visible light

- Small part of the electromagnetic spectrum
- 400 to 800 nanometers
- Light refracts (bends) when traveling across mediums
- Blue refracts more, red refracts less



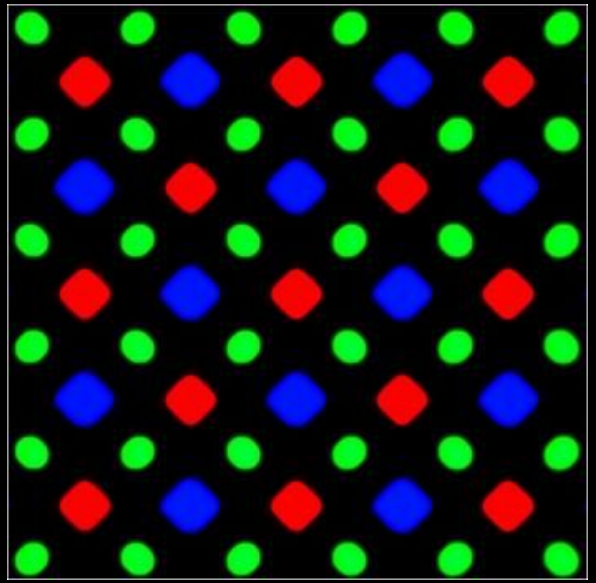
Chromatic aberration

- Different wavelengths of light are focused at different places within the eye
- Red and blue are the very end
- Our eyes adapt, but can’t focus both red and blue at the same time

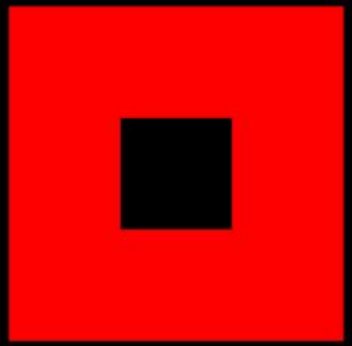
Most people see red closer than the blue but some see the exactly opposite effect

Subpixel arrangement of present VR displays

- Green subpixels are more compared to red & blue
- Green also refracts the least when seen through the lens

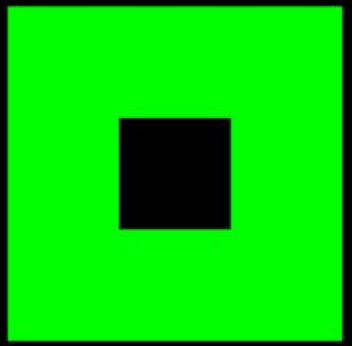


Colors differ in luminosity levels



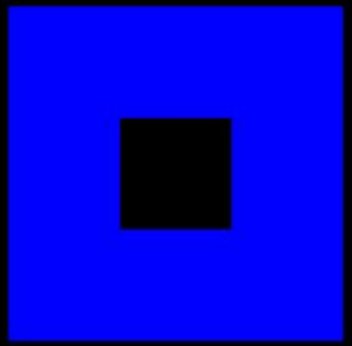
RGB 255,0,0

5.3 : 1



RGB 0,255,0

15.3 : 1

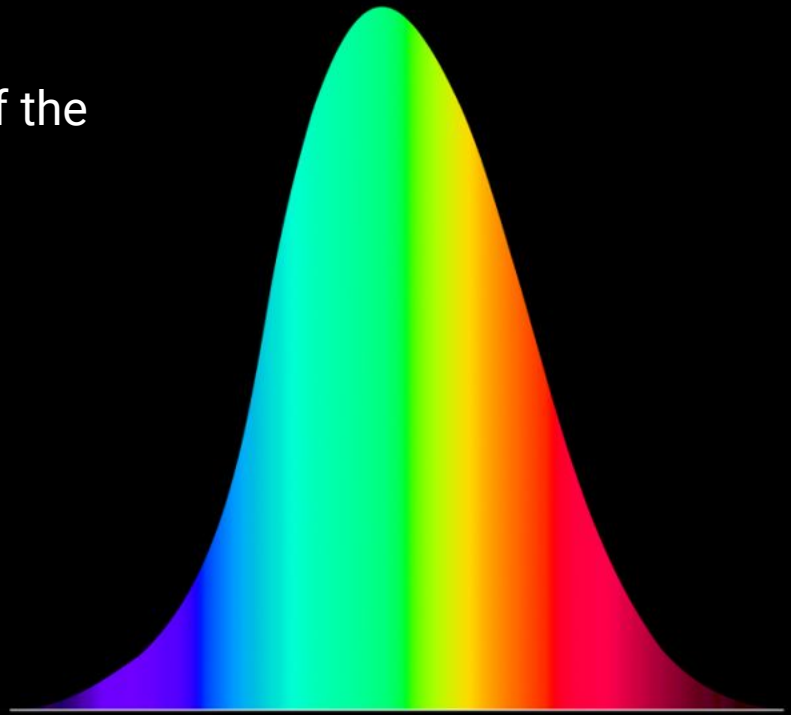


RGB 0,0,255

2.4 : 1

Color response curve

- Our eyes respond more to green part of the spectrum compared to other colors

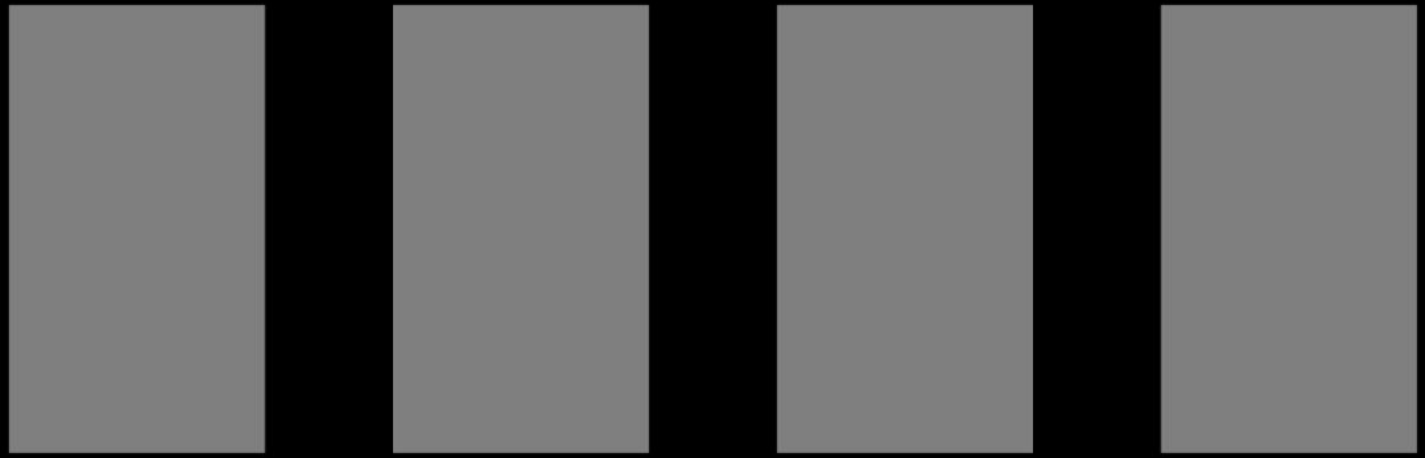


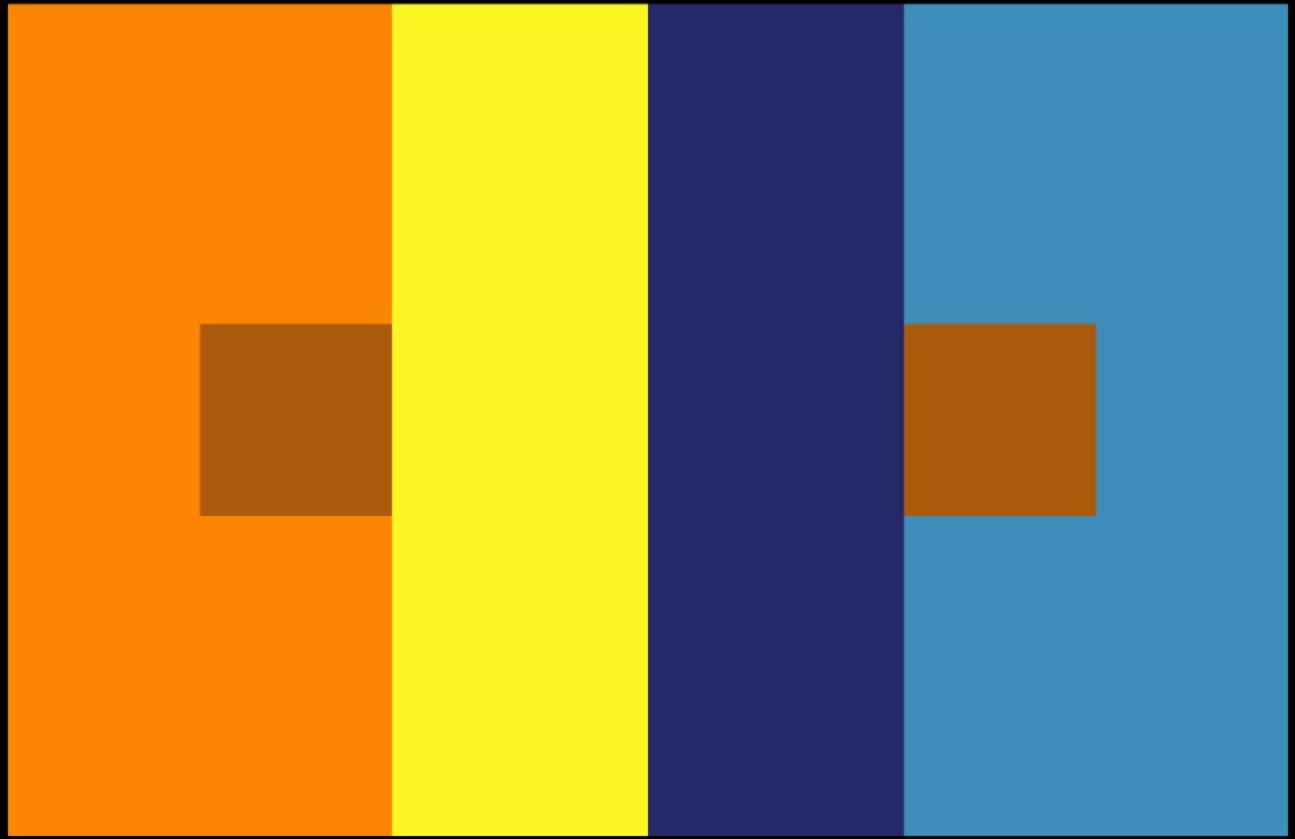
How we use this

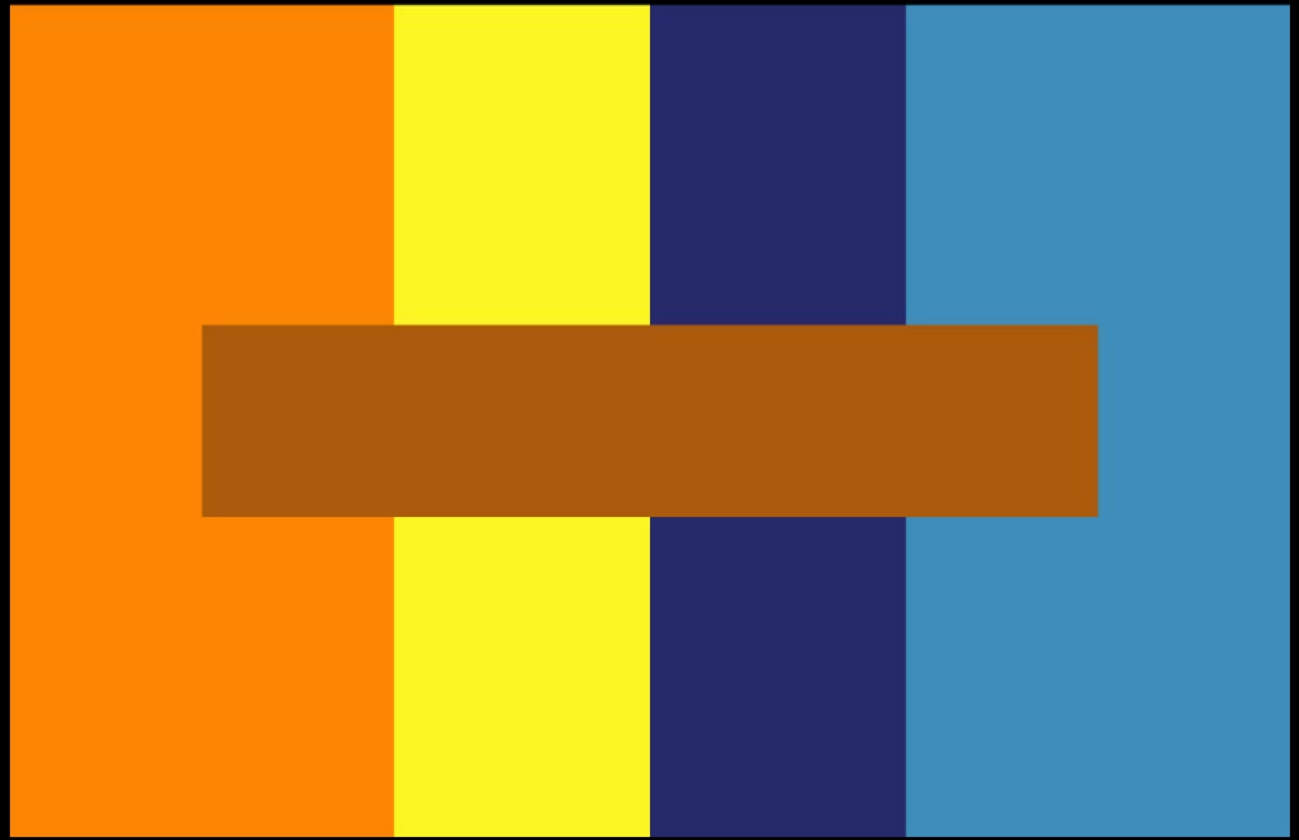
- We use green & white as the primary colors for the majority of our UI elements
- Ensures in clean and crisp readable text at all times

Vision is perceived as differences, not absolutes

- Nerves transmit nothing about the amount of light falling on the retina
- They signal the relative amount of light
- How a patch of light differs from a neighbouring one
- How a particular patch of light has changed in the past instant
- Perception of light is nonlinear
- Implications on grey-scale coding of information





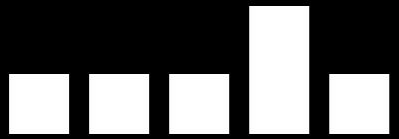


We are naturally drawn to areas of contrast

Our gaze is drawn to high contrast areas

Madame Henriot by Auguste Renoir

Types of contrast



Size

Position

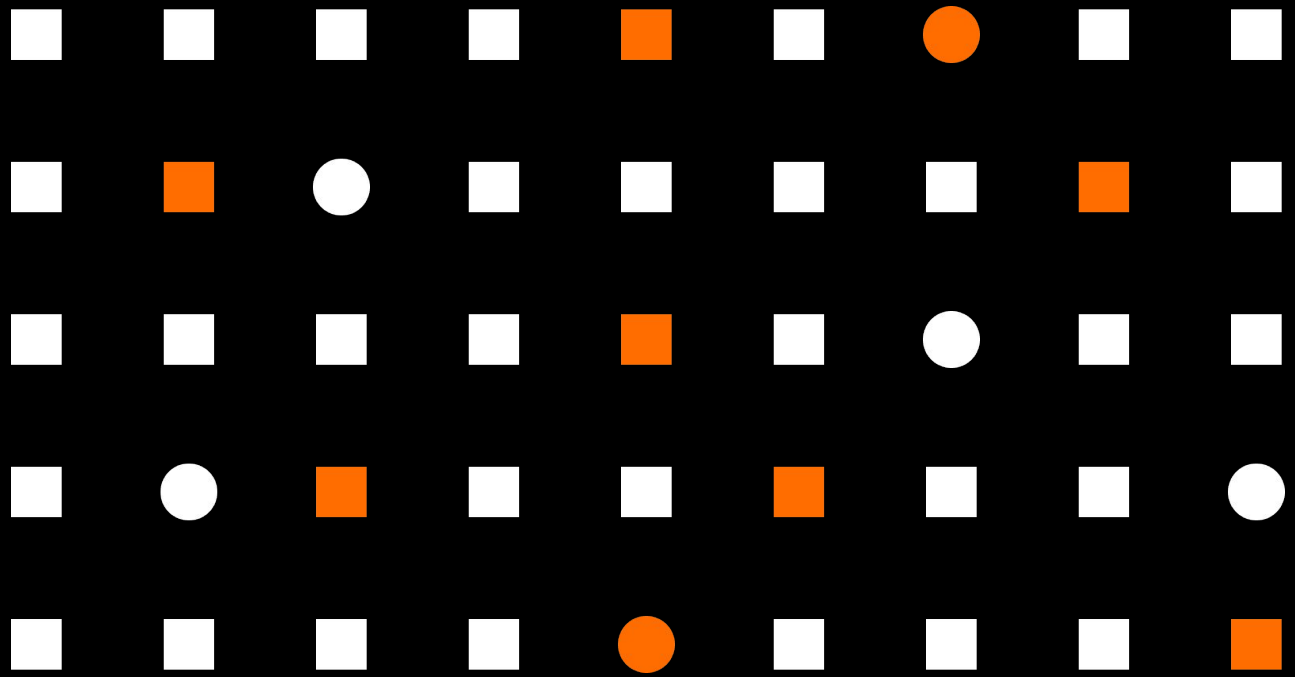
Color

Shape

Orientation

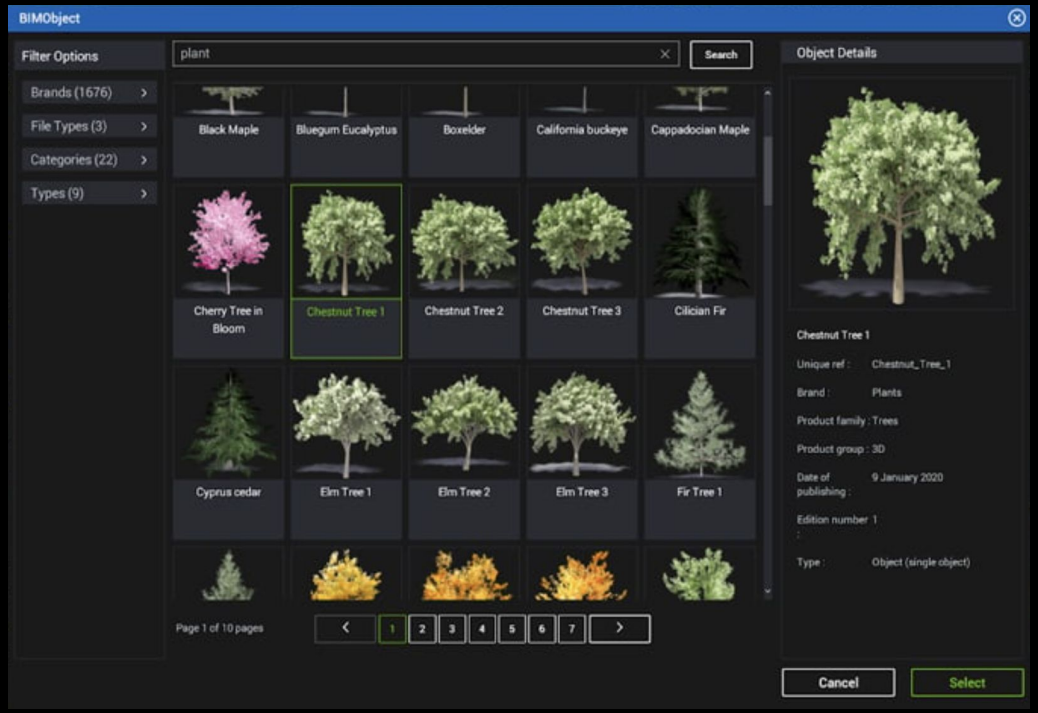
Texture

The brain can only focus on one type at once



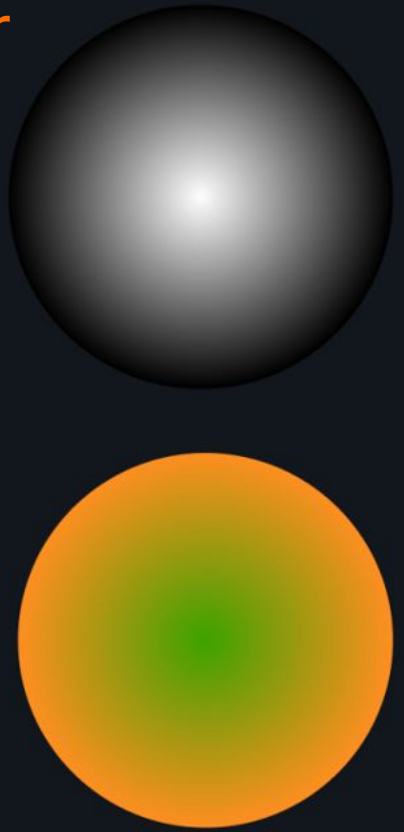
How we use it

- Only neutral shades and levels in UI, specially when displaying colored and user defined content
- Use contrast to define areas of focus and interest
- Don’t use multiple contrast types together



Luminance in more important than color

We see depth in luminance, not color



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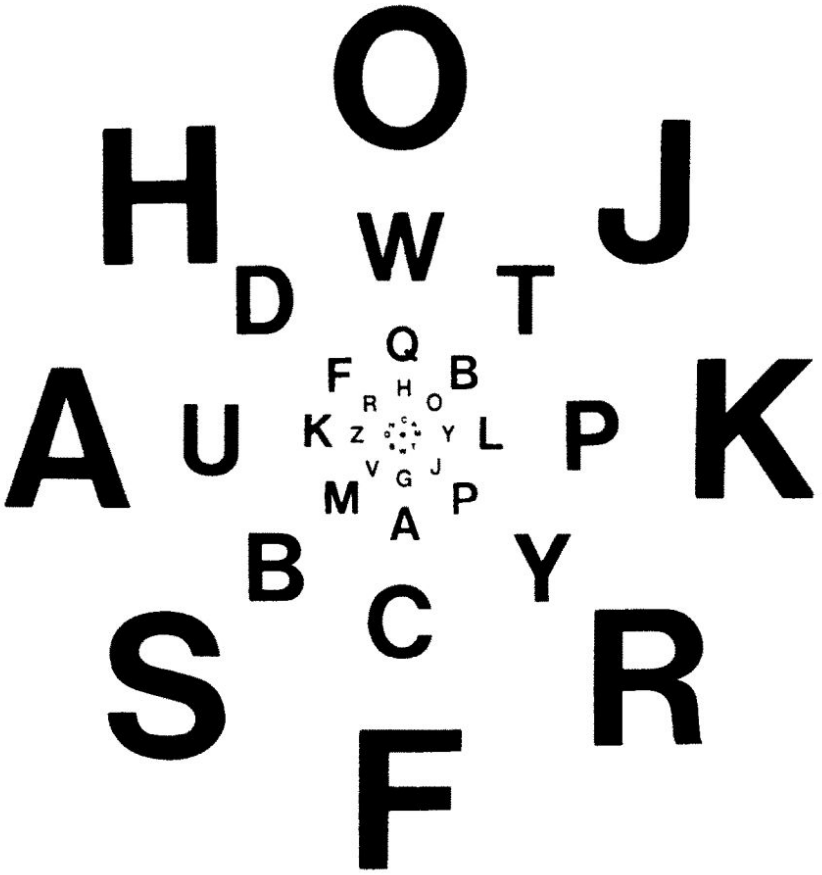
How we use it

We ensure that all of our text has a luminous contrast of at least 7:1

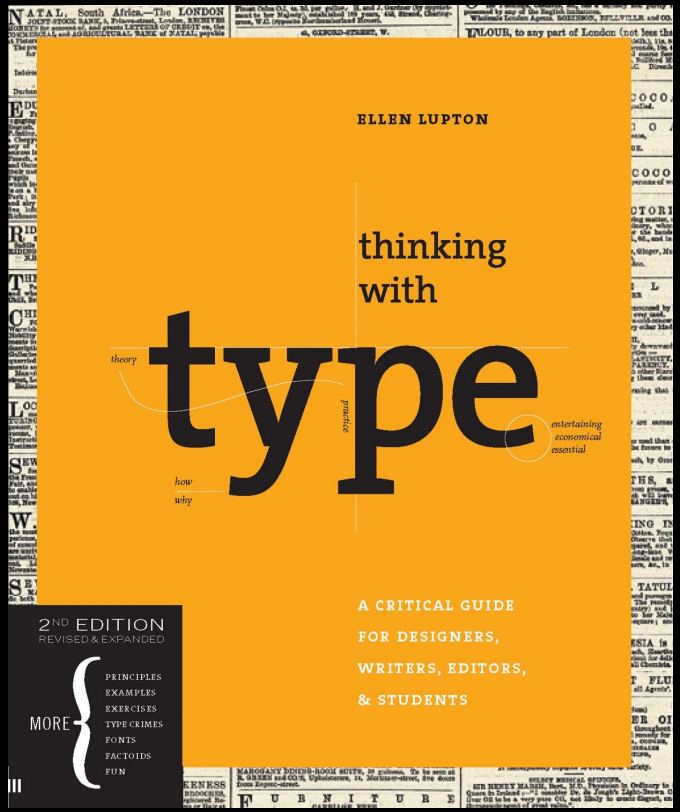
Stuart Anstis eye chart

Ensure all text in VR is +2 more than the real life value on the Peripheral acuity chart



Further reading

Vision and Art: The Biology of Seeing by Margaret S. Livingstone



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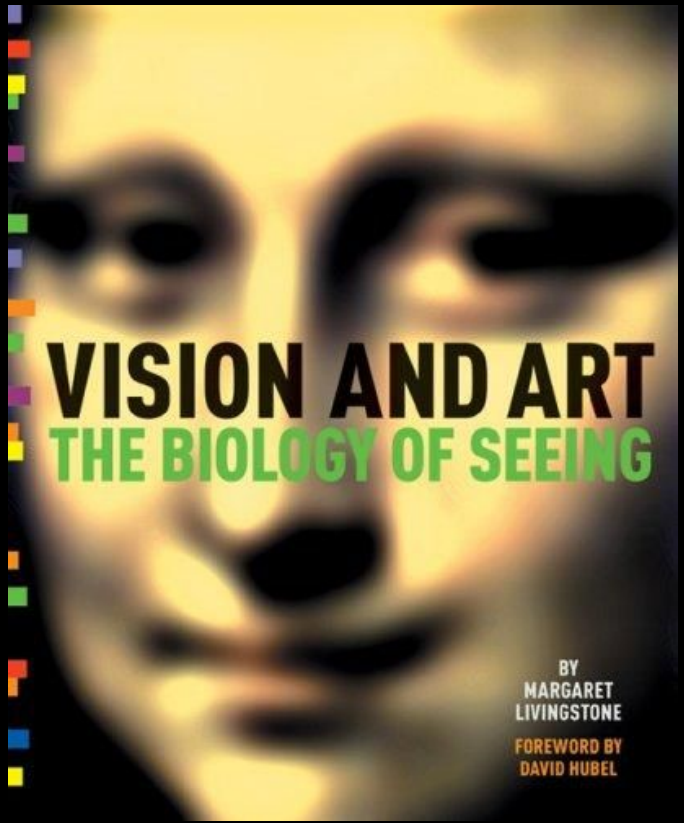

Further reading

Interaction of Color by Josef Albers

Test, test, test

- Only way to figure out what works and doesn’t
- Modify SDK samples from Oculus / SteamVR for quick test setups
- Understanding human perception helps make decisions

Questions?