Notes and Outputs - Lab 2

Task 1 - Finding the blind spot

The blind spot (scientifically known as the **scotoma**) is the specific region of the retina where the **optic nerve** exits the eye to carry visual information to the brain.

- **Lack of Photoreceptors**: Because the optic nerve takes up this space, there are no light-sensitive rods or cones in this specific area.
- **No Light Detection**: Any light or image that falls exactly on this spot cannot be detected by the eye.

What You Should Observe in the Video

As you follow the video instructions—typically closing one eye and focusing on a fixed point while a second object moves into your periphery—you will notice:

1. **The Disappearing Act**: At a specific distance and angle, the moving object will suddenly vanish from your sight.
2. **Filling-In**: You won't see a "black hole" where the object was. Instead, your brain performs **spatial completion**. It looks at the surrounding background (the white of the screen or the pattern of the grid) and "paints" that same color over the blind spot.
3. **Brain over Eye**: This proves that what you "see" is a mental reconstruction. Your brain hide's the eye's physical flaws by guessing what *should* be there.

Why don't we notice this normally?

- **Binocular Vision**: Since your eyes are in slightly different positions, the left eye see's what is in the right eye's blind spot and vice versa.
- **Microsaccades**: Your eyes are constantly making tiny movements, ensuring the "hole" never stays over the same part of an object for long.

Task 2 - Colour Blindness Test

We managed to find all the numbers in the Isihara test, the only one which was slightly hard was the Plate 7: 45.

This reminded me of the online game 'I love hue' which takes minor hue and saturation differences to the next level by making the user sort them. The higher the levels the more perceptive to color the user has to be.

I Love Hue App - App Store

Download I Love Hue by Zut Games Ltd on the App Store. See screenshots, ratings and reviews, user tips and more games like I Love Hue.

apps.apple.com

Task 3 - Flag

Why it happens: Neural Adaptation

Staring at the inverted colours in the provided image, the following things happen in your the system:

- **Photoreceptor Fatigue**: The cone cells in your retina that are sensitive to specific colours (green, black/darkness, and yellow) become overstimulated and "tired" after 10–30 seconds of constant staring.
- **The Opponent Process Theory**: Your visual system processes colors in opposing pairs: **Red vs. Green**, **Blue vs. Yellow**, and **Black vs. White**.
- **Rebound Effect**: When you suddenly shift your gaze to a neutral white sheet of paper (which contains all color wavelengths), the "tired" cones cannot respond as strongly as the "fresh" ones. For example:
  - The **green-sensitive** cones are exhausted, so the **red-sensitive** signal dominates, making the stripes look red.
  - The **yellow-sensitive** cones are exhausted, allowing the **blue** signal to take over in the star field.
  - The **black** areas leave the white-sensitive receptors fresh, causing the black stars and stripes to appear bright white.

Task 4 - Troxler's Fading

The Phenomenon: Troxler's Fading

Troxler's Fading (or the Troxler effect) occurs when an unchanging stimulus in the peripheral vision eventually disappears from our awareness.

- **Neural Adaptation**: Neurons in the visual system stop responding to unchanging stimuli. By staring at the central cross, the stationary background dots become "old news" to your brain, which then filters them out to focus on changes.
- **Rigidity of the Retina**: Because your eyes make tiny, involuntary movements (microsaccades), the edges of objects usually shift slightly across different photoreceptors, keeping the image "fresh". When you focus intensely on the center, you minimize these shifts, allowing the peripheral dots to fade into the background color.

The Color Shift: Why do you see Green?

In the **purple_dots.mp4** video, as the "gap" moves around the circle, you likely see a ghostly **green** dot following the rotation.

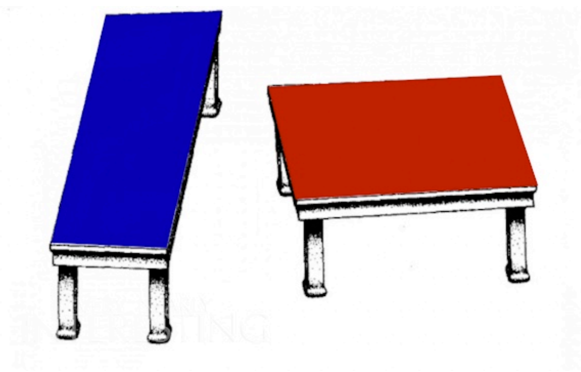
- **Successive Contrast**: Just like the American Flag experiment, your purple-sensitive (magenta) photoreceptors become fatigued.
- **Opponent Colors**: In the color-opponent system, green is the opponent to magenta/purple. When the purple stimulus is "removed" by the moving gap, your fatigued cells rebound, and your brain perceives the complementary color—green—in that empty space.

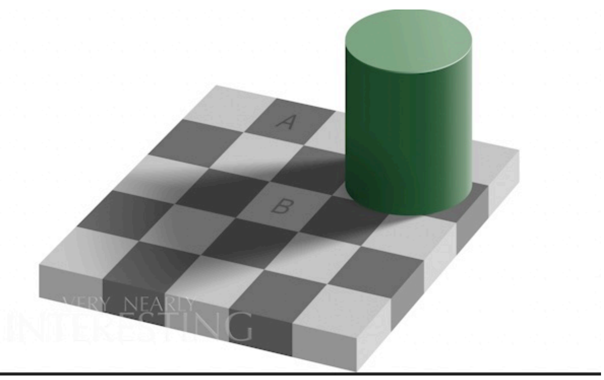
Comparison of the Experiments

Video	Primary Effect	Perception
Purple Dots	**Opponent Process**	A green "afterimage" dot rotates where the purple dots are missing.
Blue Circle	**Troxler's Fading**	The blue fuzzy circle gradually dissolves into the gray background until it disappears entirely.

Key takeaway for Design Engineers: Our visual system is optimized to detect **changes** (motion, flickering, sudden edges) rather than static states. This is why constant noise in an image is so distracting—it forces the brain to work harder to filter it out.

Task 5





In this image, square **A** and square **B** are actually the **identical shade of gray**.

- **The Phenomenon:** Most observers perceive square A as dark gray and square B as light white/gray.
- **The Reason:** This is a result of **lightness constancy** and local contrast.
    - **Shadow Compensation:** Your brain notices the green cylinder casting a shadow. It "knows" that objects in shadow reflect less light, so it mentally "boosts" the brightness of square B to compensate, assuming it must be a "white" square that just happens to be in the dark.
    - **Local Contrast:** Square A is surrounded by lighter squares, making it look darker by comparison. Square B is surrounded by darker squares, making it look lighter.

Task 6: The Grid Illusion (Hermann Grid)

As you stare at the grid, ghostly gray or black dots appear at the intersections of the white lines, but vanish when you look directly at them.

- **The Reason**: This is caused by **lateral inhibition** in the retina. The photoreceptors at the intersections receive more "inhibitory" signals from the four surrounding white paths compared to the receptors in the middle of a line, which only have two white neighbors.
- **The Result**: The brain perceives the intersection as darker because of this concentrated inhibition. It disappears when you look directly at it because the center of your vision (the fovea) has a higher density of receptors and smaller receptive fields, making it less susceptible to this neighboring interference.

Task 7: Café Wall Illusion

Despite the horizontal lines appearing to tilt or converge, they are actually **perfectly parallel**.

- **The Reason**: This illusion is driven by the high-contrast "tiles" and the thin gray mortar lines between them. Your brain's edge-detection neurons become "confused" by the staggered black-and-white patterns, causing the gray lines to be perceived as part of the tiles themselves.
- **Low Contrast Effect**: As you observed with the second image, when the contrast is lowered, the signal to the edge-detection neurons is weakened, and the "tilting" effect disappears because the brain can more accurately identify the straight boundaries.

Task 8: The Silhouette Illusion (Spinning Dancer)

This is an example of an **ambiguous 3D stimulus**.

- **The Reason**: Because the dancer is a silhouette, there are no depth cues (like highlights or shadows) to indicate which way she is facing.
- **The Result**: Your brain has to "choose" a direction of rotation. Since the image is mathematically consistent with both clockwise and counter-clockwise rotation, your brain may eventually get "bored" with one interpretation and switch to the other, making it look like she suddenly changed direction.

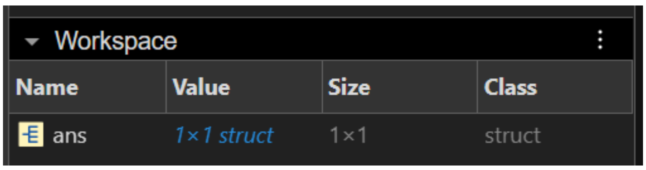
Task 9: The Incomplete Triangles (Kanizsa Triangle)

When looking at this image, most people see **two overlapping triangles** (one pointing down with a solid border, and one pointing up that appears "whiter" than the background).

- **The Answer**: Technically, there are **zero** complete triangles in the pixel data; there are only three "Pac-Man" shapes and three V-shaped lines.
- **Conclusions**: This demonstrates **amodal completion** and the **Gestalt principle of Closure**. Our brains are evolved to find patterns and fill in missing information to identify objects quickly, even when part of the object is missing or obscured.

Part 2 - Matlab

```
imfinfo('peppers.png')
```


Workspace

Name	Value	Size	Class
ans	1×1 struct	1×1	struct

Task 10 - Convert RGB image to Grayscale

```
RGB = imread('peppers.png');
imshow(RGB)
```

```
I = rgb2gray(RGB);
figure                  % start a new figure window 'figure 2'
imshow(I)
```

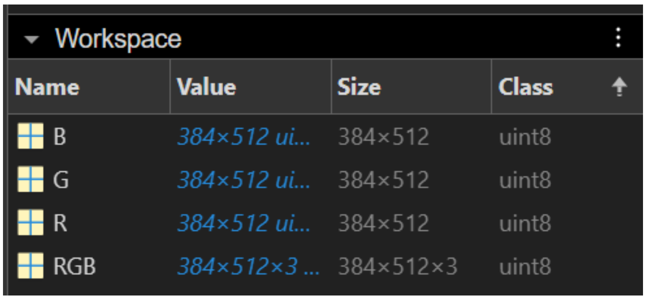
I	384×512 ui...	384×512	uint8
RGB	384×512×3 ...	384×512×3	uint8

```
imshowpair(RGB, I, 'montage')
title('Original colour image (left) grayscale image (right)'); % title
```

Task 11 - Splitting an RGB image into separate channels

```
[R,G,B] = imsplit(RGB);
```

Output:



Workspace

Name	Value	Size	Class
B	384×512 ui...	384×512	uint8
G	384×512 ui...	384×512	uint8
R	384×512 ui...	384×512	uint8
RGB	384×512×3 ...	384×512×3	uint8

```
montage({R, G, B},'Size',[1 3])
```

Output:

Task 12 - Map RGB image to HSV space and into separate channels

```
HSV = rgb2hsv(RGB);
[H,S,V] = imsplit(HSV);
```

Output - created objects same structure as imread and imsplit(RGB)

```
montage({H,S,V}, 'Size', [1 3])
```

Task 13 - Map RGB image to XYZ space

```
XYZ = rgb2xyz(RGB);
[X,Y,Z] = imsplit(XYZ);
```

Output - created objects same structure as imread and imsplit(RGB)

```
montage({X,Y,Z}, 'Size', [1 3])
```