

Saturday Open Lab

Color Vision Inquiries

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CONTENT GOALS

1. Perceived color of object depends on more than just its color:
 - Depends on surrounding background color
 - Depends on overlying foreground color

Color Induction

2. A color is perceived as being lighter when surrounded by a darker background than the same color when surrounded by a lighter background.
3. The color of an object is perceived as being lighter when a lighter color is overlaid on top of it than the same color overlaid by a darker color.
4. The greater the overlapping surface area between the overlaid color and the object, the stronger the perception.

Color Constancy

5. Even though the color information from the white square is the same for both the small filter and the filter covering the entire scene, it is perceived as a different color in these two situations.
6. Visual system takes into account the appearance of surrounding objects (check this by walking towards the overhead screen until the white square with small filter takes up entire field of view.
7. Visual system adjusts its chromatic sensitivity based on the average illuminant (normalization).
8. This is similar to the concept of brightness constancy...

COLOR INQUIRY 1

Color Induction - Center for Adaptive Optics

MATERIALS

1. Several pieces of paper with the words 'Center' and 'for' having the same color, and the words 'Adaptive' and 'Optics' having the same color (which is different from the words 'Center' and 'for'). These words are listed vertically in the same column and are surrounded by a rectangular background with the same or different background. There are several permutations for the students to play with. (Examples listed below.)



Fig. 1-1



Fig. 1-2



- Several rectangularly cut transparencies with lines printed horizontally, circularly, or in a saw-tooth pattern. These lines can vary in density, thickness and color and are to be overlaid on the pieces of paper to study the process of color induction. (Some examples are shown below.)

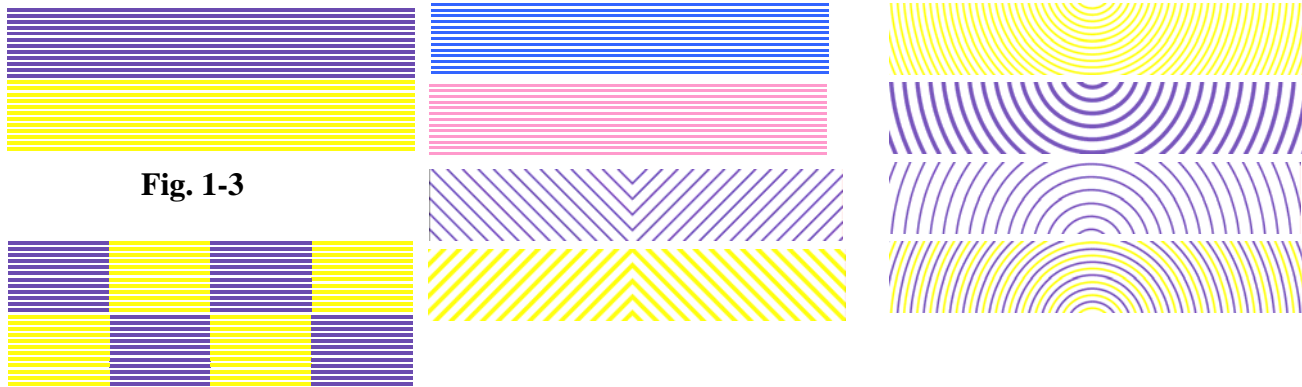


Fig. 1-3

- Scissors.
- Blank overhead transparencies.
- Blank white and colored pieces of paper.
- Markers of different color.
- Ruler.
- Tape.
- Holepunch.
- In addition, have the capability to make and printout different color overlays/words/backgrounds in real-time if students want a combination not provided.

TEASER

- Present the image shown in Fig. 1-1 in which the words 'Center' and 'for' are a shade of green surrounded by a gray background and the words 'Adaptive' and 'Optics' are a shade of orange surrounded by the same gray background.
- Present the image shown in Fig. 1-2 in which the words remain constant from Fig. 1-1, but only the background color has changed. Try to get the audience to focus in on differences in color between the two words in the top grouping ('Center' and 'for') and the two words in the bottom grouping ('Adaptive' and 'Optics'). Depending on the gamut of the projector, the audience may be able to notice that the word 'Center' appears slightly darker than the word 'for' and the word 'Adaptive' appears slightly darker than the word 'Optics.'
- Now, overlay the pattern of stripes shown in Fig. 1-3 on top of both word groupings to look as shown in Fig. 1-4:



Fig. 1-4



Fig. 1-5

Again, make certain to have the audience focus their attention on looking for color differences within a pairing of words, such as between 'Center' and 'for' and between 'Adaptive' and 'Optics.' To make this effect more believable (if done using PowerPoint), slide the horizontal bars across the two word groupings using custom animation features (as illustrated in Fig. 1-5). The words 'Center' and 'for' should obviously appear different in color, as should 'Adaptive' and 'Optics.' What's going on?

QUESTIONS GENERATED FROM SMALL GROUP INQUIRY STARTER:

1. What effect do the stripes have on a color's appearance?
2. What effect does the density of stripes have?
3. Is this phenomena related to color blindness?
4. Does stripe orientation have an impact on color appearance?
5. Why do some colors make text look redder or more orange?
6. What stripes have the most effect on the same colored lettering?
7. Why do backgrounds look different with different color text?

COLOR INQUIRY 2

Color Constancy - Squares and Filters

MATERIALS

1. Pieces of paper and overhead transparencies containing printed squares of differing color with at least one white square. (Some examples are shown below.)

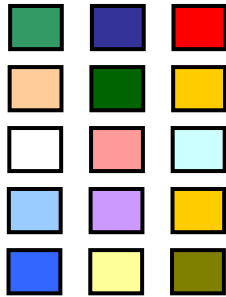


Fig. 2-1



Fig. 2-2

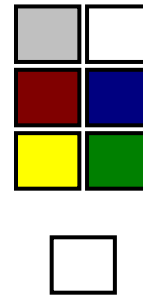


Fig. 2-3

2. Sheets of different colored overhead transparencies.
3. Small squares cut out from the same colored overhead transparencies that are the same size as the squares printed on the pieces of paper and overhead transparencies.
4. Sheets of gel filters (Roscolux, Filter # 02 - Bastard Amber; Filter #06 - No Color Straw; Filter #397 - Pale Grey; Filter # 66 - Cool Blue; Filter # 87 - Pale Yellow Green)
5. Small squares cut out from the same colored gel filters that are the same size as the squares printed on the pieces of paper and overhead transparencies.
6. Overhead projectors.
7. Tape.
8. Scissors.
9. Ruler.
10. Holepunch.
11. Markers.

TEASER

1. The teaser can be illustrated using the slides in Fig. 2-4 through Fig. 2-8. One can begin with Fig. 2-4 to show the initial color of the squares to the audience.
2. Fig. 2-5 shows the next slide which simply contains the 6 original colored squares and a light purple gel filter that is laid on top of a subset of the squares. This filter is the same size as each of the 6 colored squares.
3. Fig. 2-6 shows the appearance of the initially white square when the filter is placed on top of it. Ask the audience what color the square now appears. Hopefully, they will respond with light purple.
4. Now place the filter over the square that was initially yellow and ask the audience what color the square now appears. This slide is illustrated in Fig. 2-7. Hopefully, they will respond with something that is a shade of gray or brown. At this point, one can summarize what has been observed. Placing a purple gel filter over the white and yellow squares caused the squares to change in their color appearance.
5. Now, tell the audience that you are going to place a gel filter over the entire image, as illustrated in Fig. 2-8. What is the color appearance of the initially white and yellow squares? They still look white and yellow when the filter is placed over the entire image, but they did not appear white and yellow when the small, square filter was placed over the individual squares. What's going on?

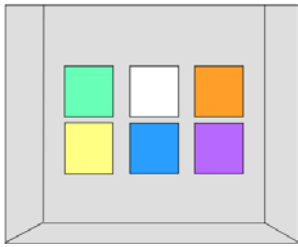


Fig. 2-4

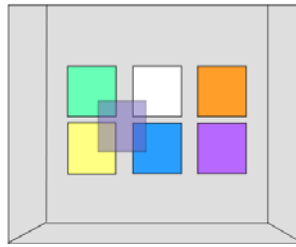


Fig. 2-5

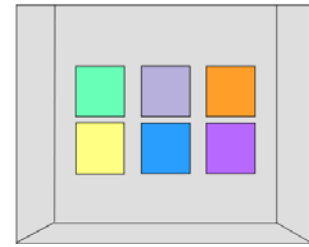


Fig. 2-6

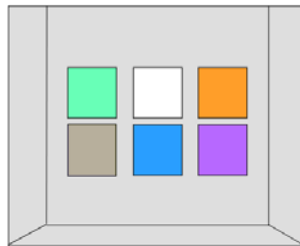


Fig. 2-7

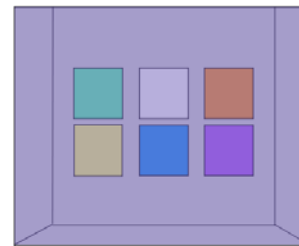


Fig. 2-8

NOTES:

- Try to make the square colors as saturated as possible on the paper and transparency printouts.
- If using the overhead transparencies on the projector, make sure to cover any areas on the overhead projector that the slide does not cover with a cardboard frame. This ensures that the only light projected on to the screen is light that passes through the transparency.

QUESTIONS GENERATED FROM SMALL GROUP INQUIRY STARTER:

1. Do stronger colored filters make more of a difference on stronger colors than on softer colors?
2. Is it always the case that there is a smaller change in color of the squares when a filter is placed on top of the entire image?
3. Does a colored square stand out more or less when the same colored filter is placed on top of it?
4. What effect does changing the background have on the overall color differences?
5. Does the spacing of the squares influence the perception?
6. Is the color of the initially yellow square when covered by a square filter physically the same as the same square when the entire image is covered by the filter? Are the squares in these two situations physically different in color or do they just appear as being different in color?