The Role of Spatial Factors in Preference for Color Pairs

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Background

Itten (1973): Colors should be combined such that the ratio of their areas is inversely proportional to the ratio of their "intensities" (Goethe, 1810):

Color	Intensity
Yellow	9
Orange	8
Green	6
Red	6
Blue	4
Violet	3

Spatial Ratio

1:1 — 6 6 — **Red and green equally intense**

2:1 — 4 8 — **Orange somewhat more intense than blue**

3:1 — 3 9 — **Yellow much more intense than violet**

We correlated these intensities with colorimetric ratings (Schloss & Palmer, VSS 2007):

- Yellowness/Blueness (r = .88)
- Lightness/Darkness (r = .52)
- Warmness/Coolness (r = .61)

Goethe's color intensities correspond best with yellowness/blueness.

Research Questions

If two color displays have identical colors in opposite spatial arrangements, will there be a preference asymmetry (one pair preferred over the other)?

Do you prefer one pair over the other?

If so…

Which color-related factors are important? (Experiment 1)

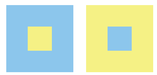
E.g., should yellower regions be smaller than bluer regions, as implied by Itten's intensity ratios?

What are the most important spatial factors that influence preference asymmetries? (Experiments 2 & 3)

E.g., relative area, surroundedness, shared contour length (perimeter)

General Methods

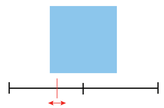
Choose which color combination is preferred, where the colors were in opposite spatial arrangements



Choose which color is preferred for single color squares

Rate each color along five colorimetric dimensions by making a line-mark along a scale from…

… **Light** to **Dark**
… **Warm** to **Cool**
… **Yellow** to **Blue**
… **Red** to **Green**
… **Unsaturated** to **Saturated**



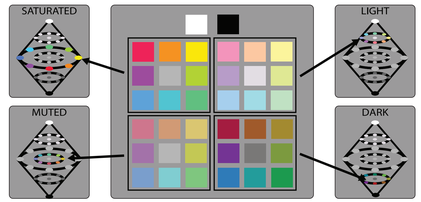
Exp. 1: Color-Based Factors in Preference Asymmetries

Displays

Center-Surround

Which pair do you prefer?
Left, right or neither?

Berkeley Color Project (BCP) 37 Colors



Tested all 1332 pairwise combinations of the 37 colors.

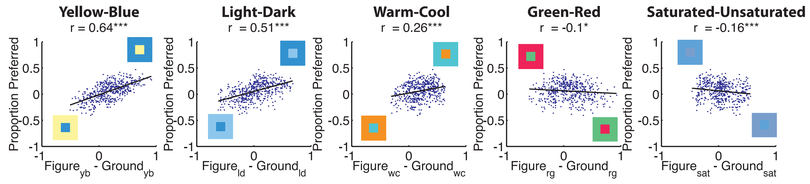
4 unique hues:
red yellow
green blue

4 angle bisectors:
orange chartreuse
cyan purple

4 saturation/lightness levels ("cuts"):
saturated light
muted dark

5 achromatic colors

Results



60% of the variance is explained by:

- Δ **Yellowness-Blueness:** People prefer yellower colors as figures and bluer colors as grounds (40%)
- Δ **Single Color Preference:** People prefer less-preferred colors as figures and more-preferred colors as grounds (11%)
- Δ **Lightness:** People prefer lighter colors as figures and darker colors as grounds (9%)

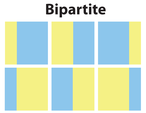
Exp. 2: Spatial Factors in Preference Asymmetries

Displays

Center-Surround

Area: small to large (figure)
Perimeter: short to long
Surroundedness: center

Bipartite



Area: small to large (left)
Perimeter: constant
Surroundedness: none

Perimeter

Area: constant
Perimeter: short to long
Surroundedness: center

Which do you prefer? **Which do you prefer?** **Which do you prefer?**

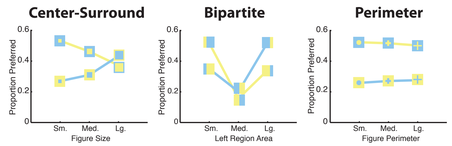
Colors

Yellowish Colors

Bluish Colors

Each pair contained one yellowish color and one bluish color

Results



61% of the variance is explained by:

- Δ **Yellowness-Blueness Size:** People prefer larger bluish regions with smaller yellowish regions (51%)
- Δ **Warmness-Coolness:** People prefer warm colors to be smaller and cool colors to be larger (10%)

Effects of Spatial Factors:

Area: Pairs are more preferred when the yellowish region is smaller than the bluish region

Perimeter: No effect

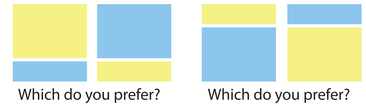
Surroundedness: No effect

Figure-Ground: Since small regions are typically figural, we cannot distinguish between effects of area and figure-ground in this experiment

Experiment 3: Area Effects without Figure-Ground

Colored regions were separated by a gap so the smaller region did not look figural.

Displays



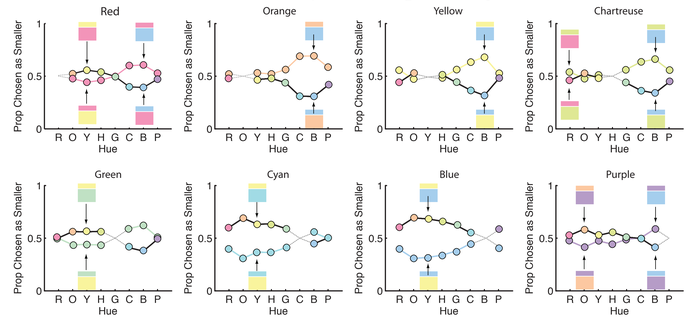
Which do you prefer? Which do you prefer?

Colors

Tested all pairwise combinations of the 16 colors.

Results

Pairs with smaller yellower regions are preferred



64% of the variance is explained by:

- Δ **Single Color Preference Size:** People prefer less-preferred colors as smaller regions and more-preferred colors as larger regions (50%)
- Δ **Yellowness-Blueness Size:** People prefer yellower colors as smaller regions and bluer colors as larger regions (9%)
- Δ **Lightness Size**: People prefer lighter colors as smaller regions and darker colors as larger regions (5%)

Conclusions

Reliable preference asymmetries show that spatial factors influence preferences for color combinations.

Relative **area** between the two regions is the most important spatial factor. People prefer combinations in which:

- yellower, warmer regions are smaller than bluer, cooler regions*
- more-preferred colors are larger than less-preferred colors
- lighter regions are smaller in center-surround displays but larger in bipartite displays

* This effect supports Itten's conjecture that people prefer yellower regions to be smaller and bluer regions to be larger.

References and Acknowledgements

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