

The Role of Spatial Factors in Preference for Color Pairs

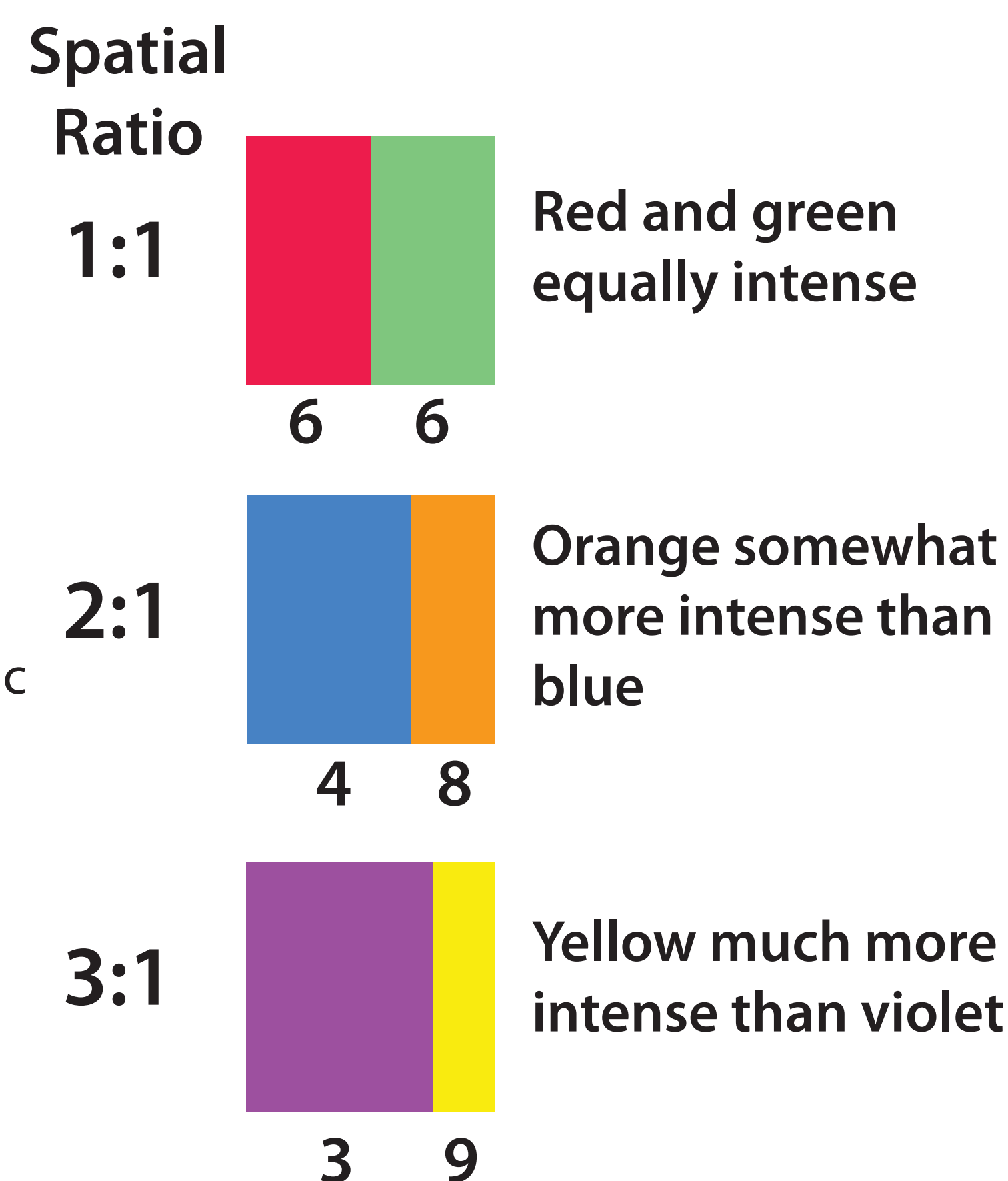
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Background

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



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)?

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?



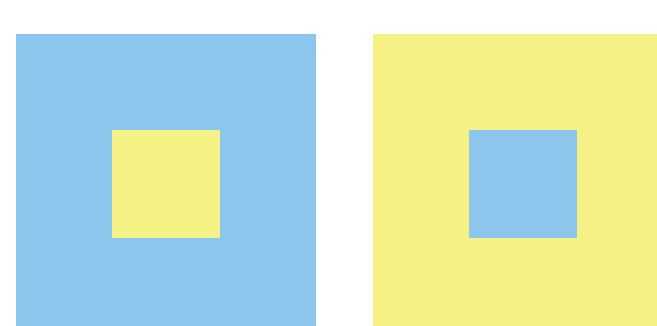
Do you prefer one pair over the other?

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

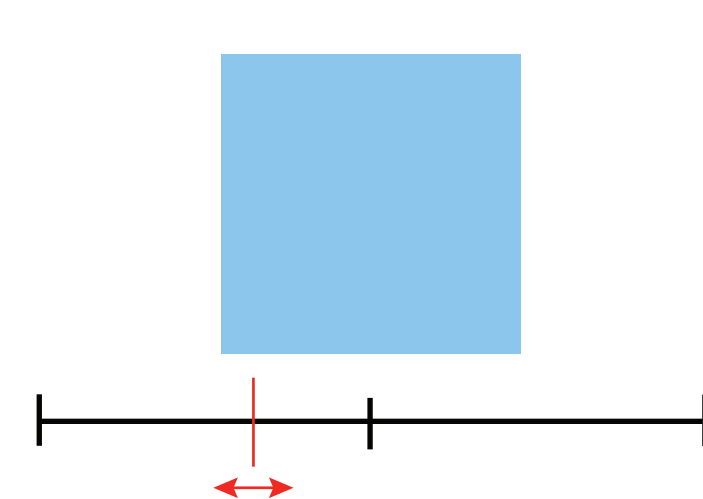


Choose which color is preferred for single color squares



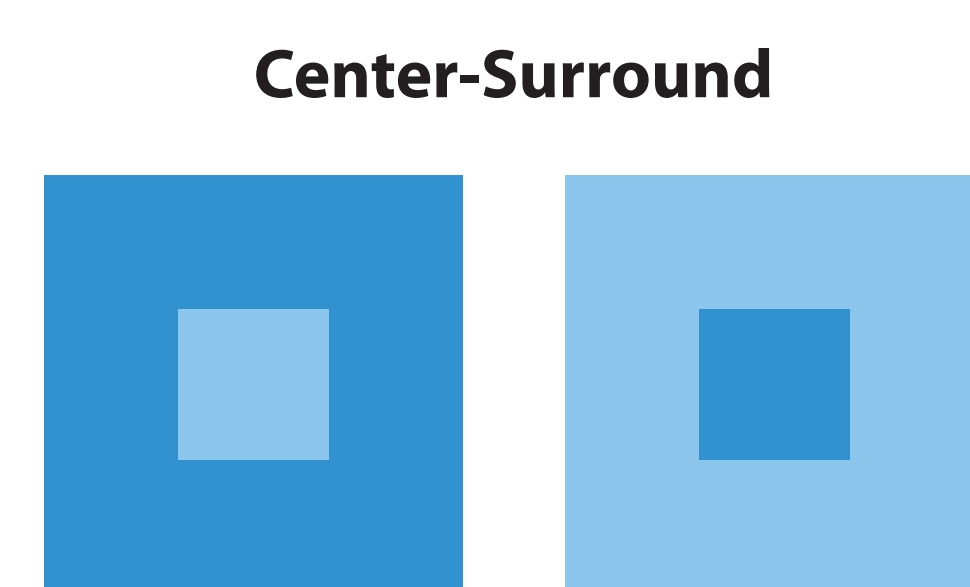
Rate each color along five colorimetric dimensions by making a line-mark along a scale from...

- ... Light to Dark
- ... Warm to Cool
- ... Yellow to Blue
- ... Red to Green
- ... Unsaturated to Saturated



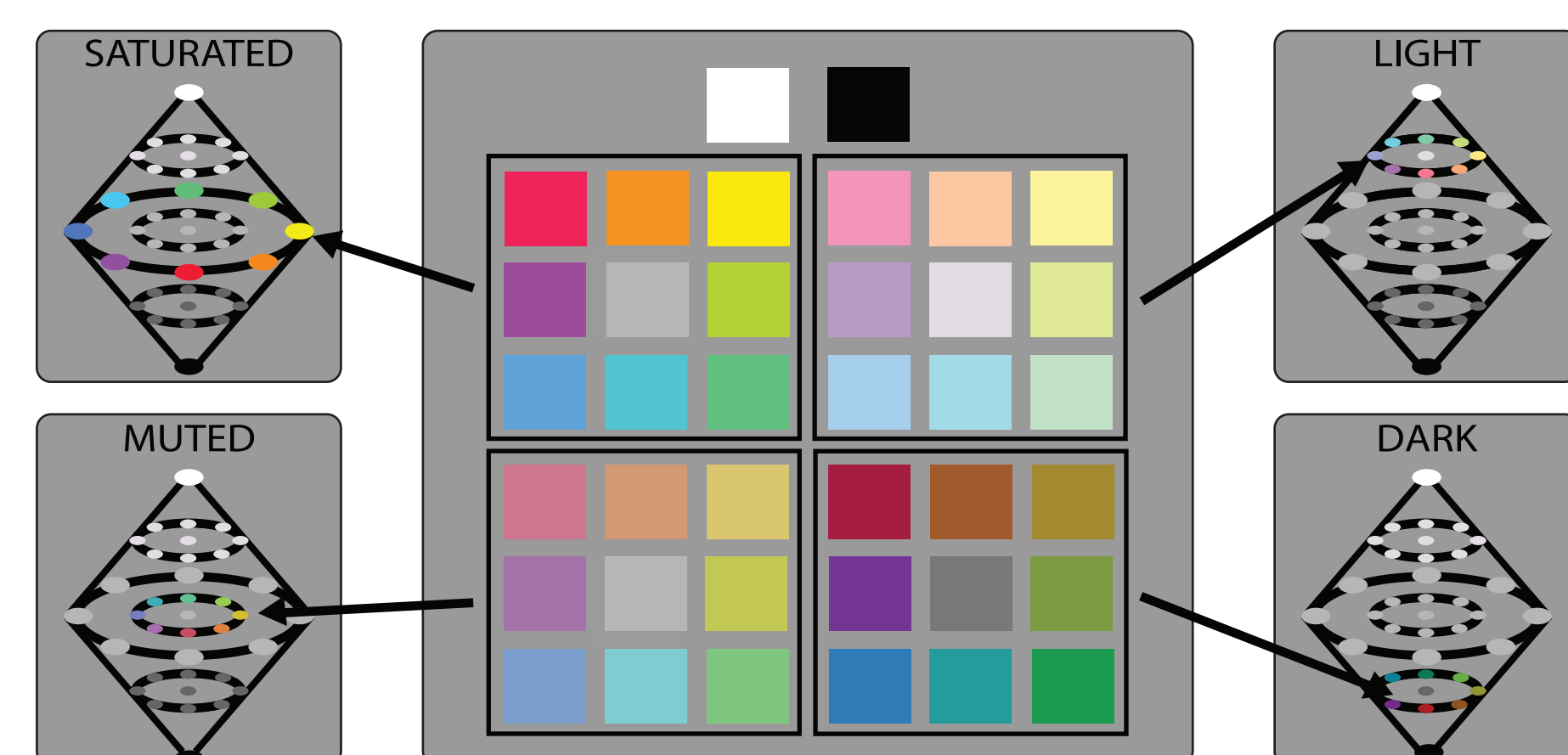
Exp. 1: Color-Based Factors in Preference Asymmetries

Displays



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

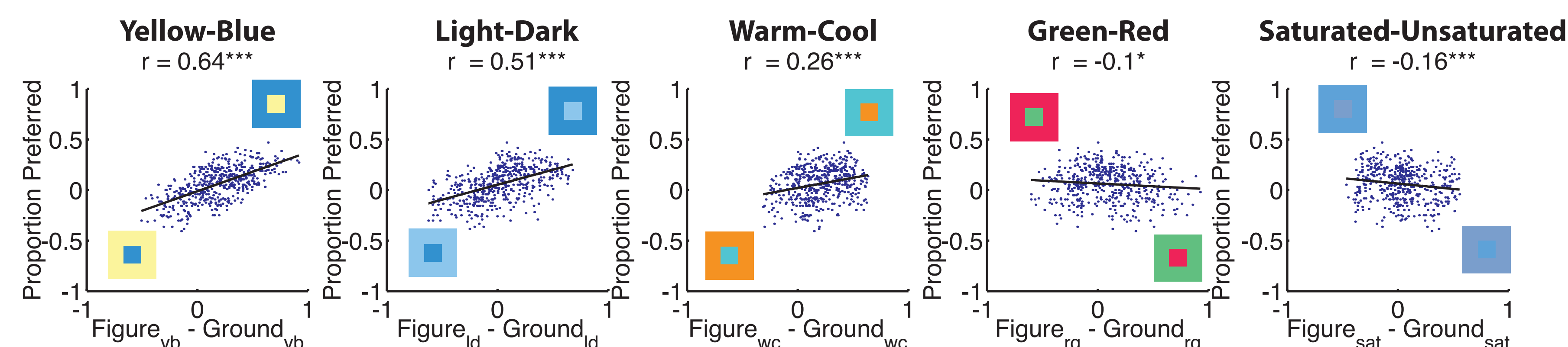
Berkeley Color Project (BCP) 37 Colors



Tested all 1332 pairwise combinations of the 37 colors.

- 4 unique hues:** red, green, blue, yellow
- 4 angle bisectors:** orange, chartreuse, cyan, purple
- 4 saturation/lightness levels ("cuts"):** saturated, muted, light, dark
- 5 achromatic colors**

Results

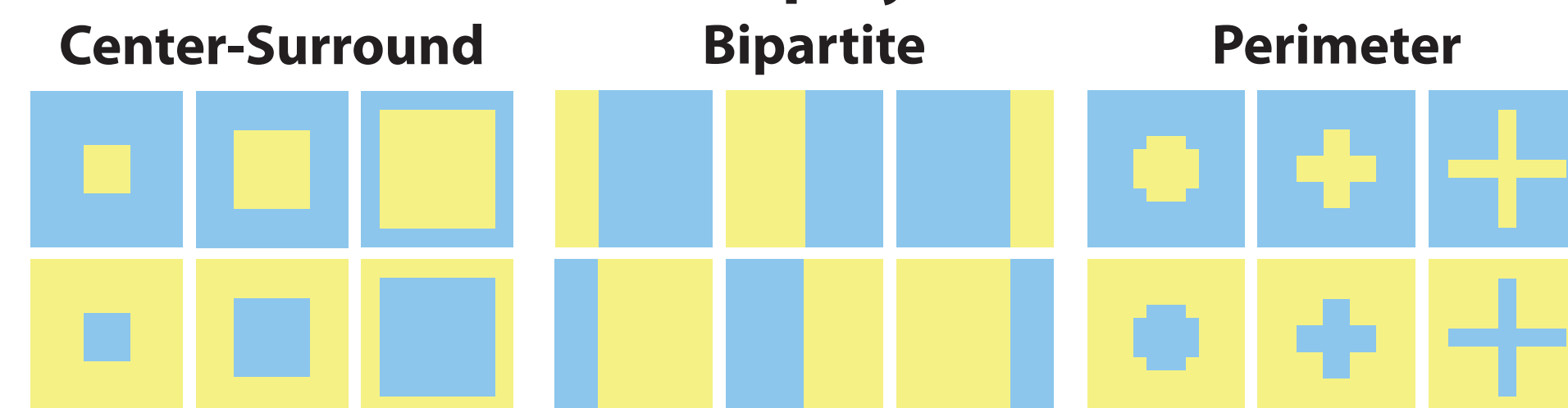


60% of the variance is explained by:

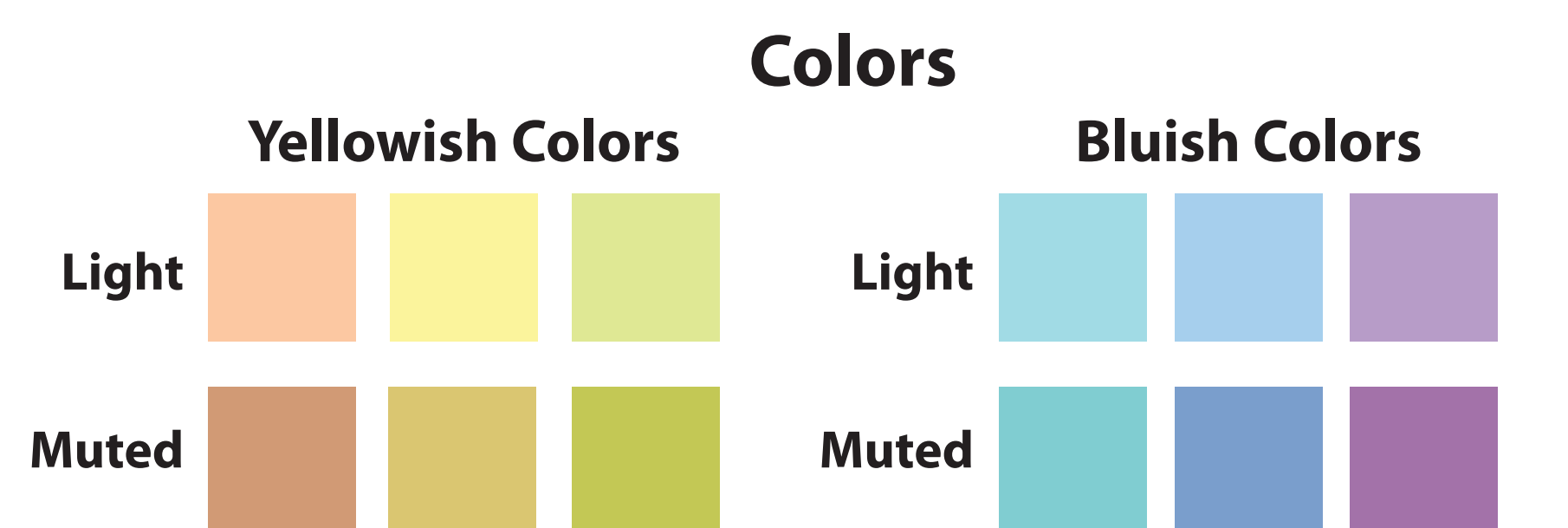
- Δ **Yellowness-Blueness:** People prefer yellower colors as figures and bluer colors as grounds (40%)
- Δ **Single Color Preference:** People prefer less-preferred colors as figures and more-preferred colors as grounds (11%)
- Δ **Lightness:** People prefer lighter colors as figures and darker colors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



Each pair contained one yellowish color and one bluish color

Effects of Spatial Factors:

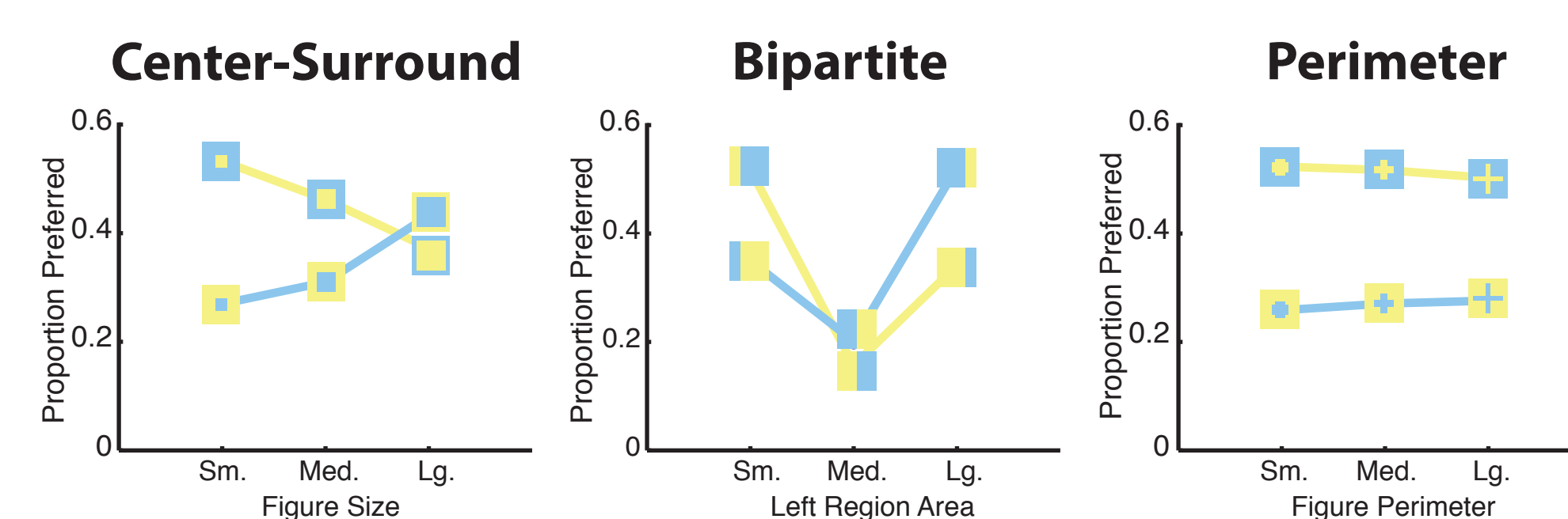
Area: Pairs are more preferred when the yellowish region is smaller than the bluish region

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

Results



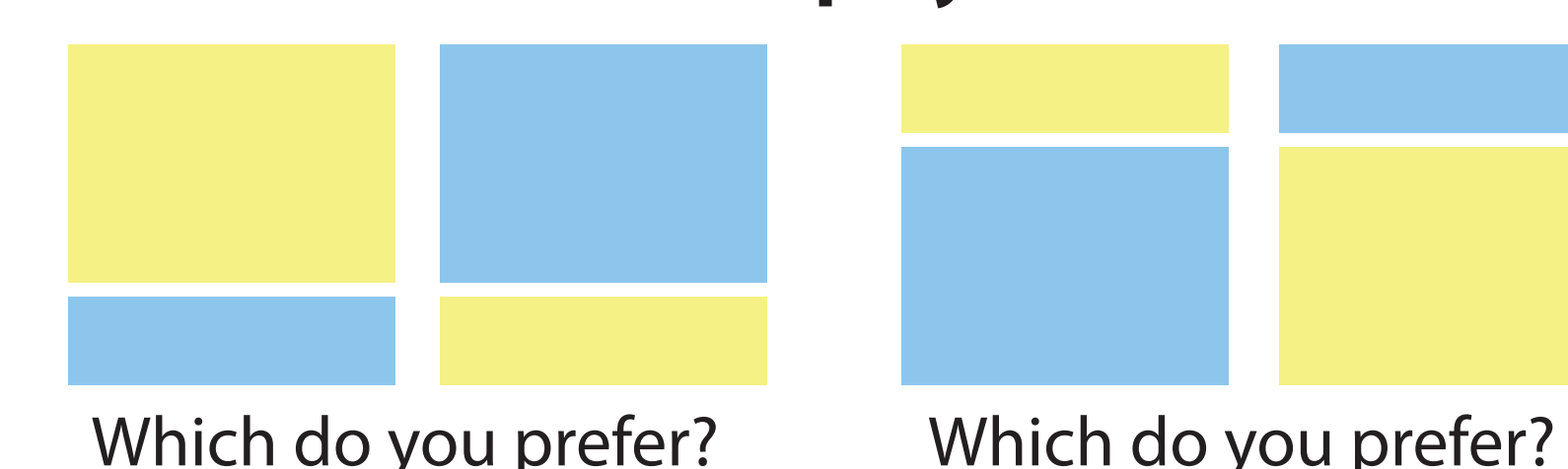
61% of the variance is explained by:

- 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%)

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?

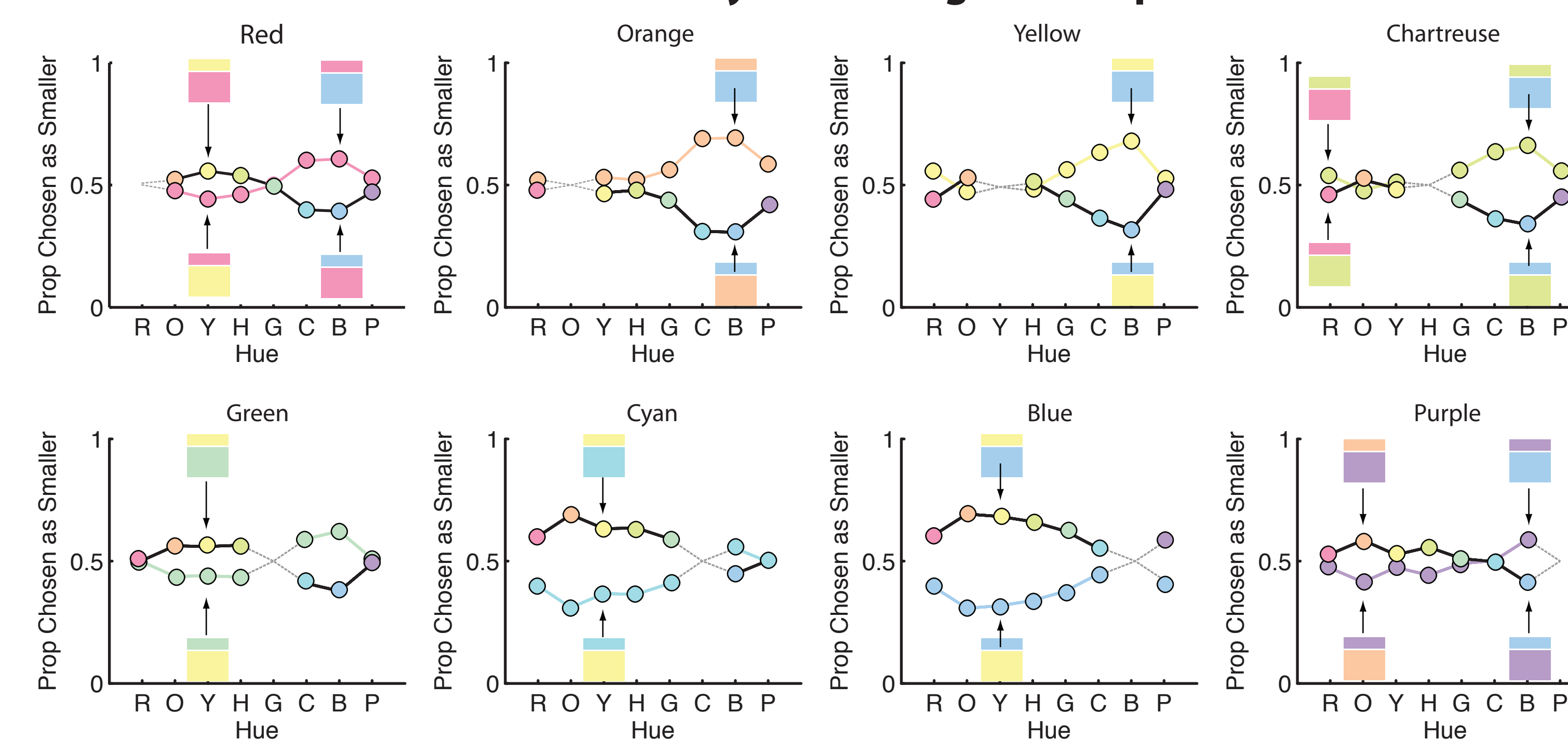
Which do you prefer?



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

Goethe, J.W. (1970). Theory of Colors. Translated by C. L. Eastlake (1840) from German edition "Farbenlehre" of 1810. Introduction by D. B. Judd. Cambridge: MIT Press.
 Itten, J. (1973). The Art of Color. Originally printed in 1961. New York: Van Nostrand Reinhold.
 Munsell, A. H. (1969) A Grammar of Color. From the original version of 1921. New York: Van Nostrand Reinhold.
 Schloss, K. B. & Palmer, S. E. "Color preferences across contexts as predicted by colorimetric variables." Presented at 7th Annual Meeting of Vision Science Society, Sarasota, FL, May 2007.
Acknowledgements:
 We thank our lab members Rosa Poggesi, Jonathan Gardner, Gary Hackett, Matt Benfield, Eli Strauss, Joseph Austerweil and Will Griscom for invaluable help in this study, and Dan Levitin (McGill University). This research was funded by the National Science Foundation grant (#BCS-0745820) to Stephen Palmer, a gift from Google, and Amy's Natural Frozen Foods.