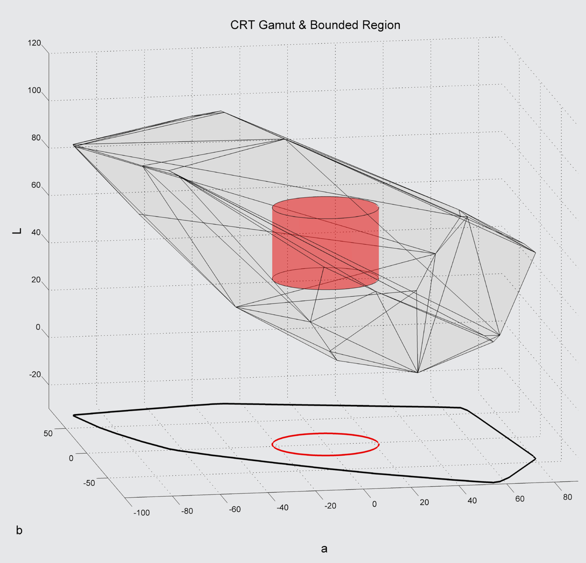
Do basic colors influence chromatic adaptation?

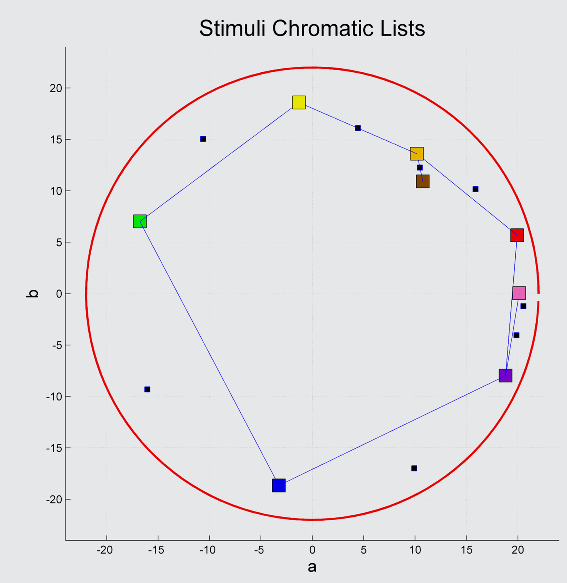
C.Alejandro Parraga[1,2], Jordi Roca-Vila[2], Maria Vanrell[1,2]
[1]Computer Science Department, Universitat Autònoma de Barcelona, Spain
[2]Computer Vision Center, Barcelona, Spain
email: jroca@cvc.uab.cat

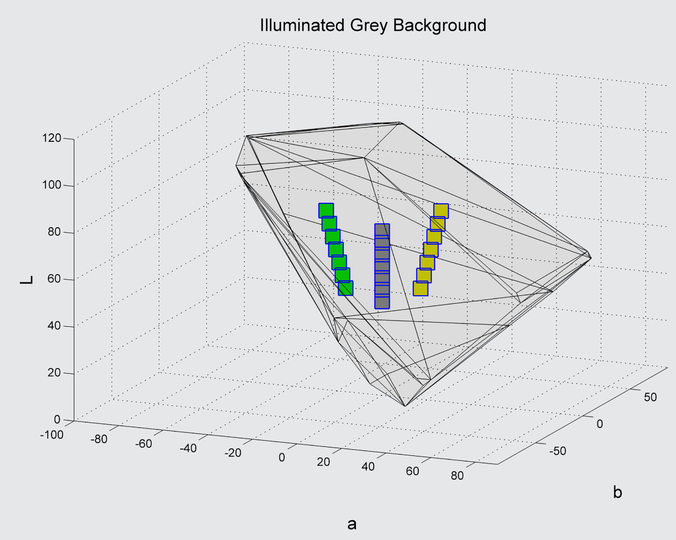
Paradigm Introduction

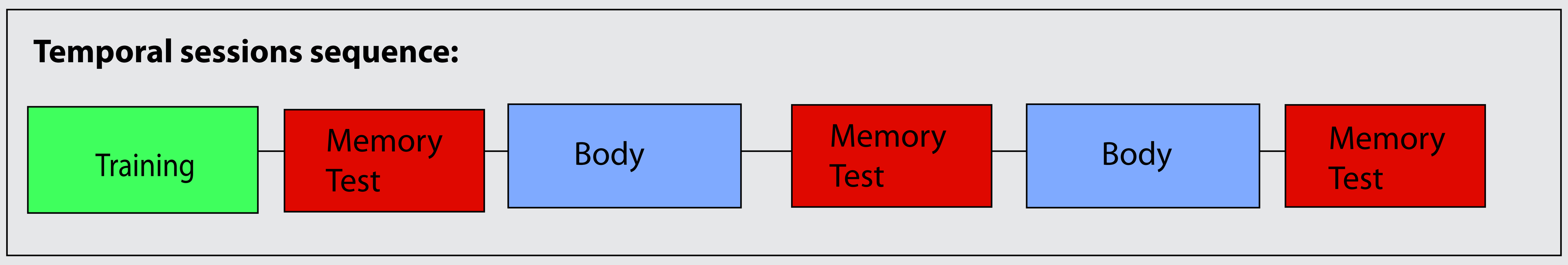
Background

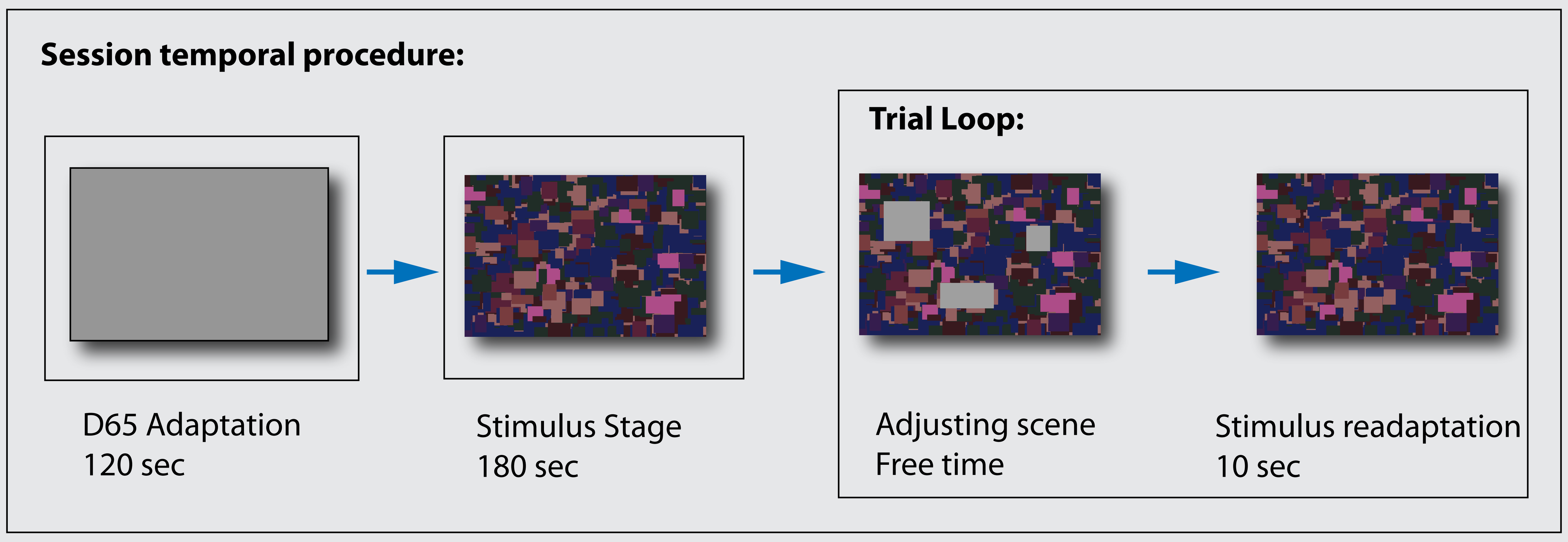
Color constancy (the ability to perceive colors relatively stable under different illuminants) is the result of several mechanisms spread across different neural levels and responding to several visual scene cues. The influence of complex chromatic backgrounds in Color Constancy remains unexplained (Shevell et al, 2008). In this work, we aim at a more comprehensive description of the phenomena and hypothesize whether the presence of certain colors, specifically those corresponding to the universal color terms proposed by Berlin and Kay (1969) could influence our perception. We have developed a new paradigm to measure successive color constancy that takes advantage of the strongest points of several common color constancy paradigms.











The Chromatic Setting Paradigm

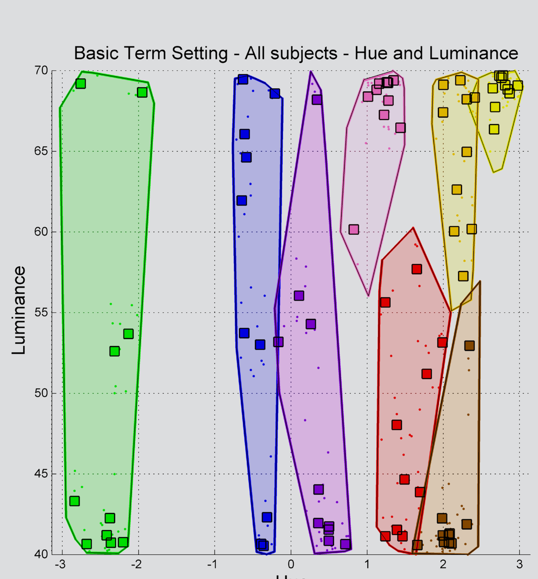
The experiment was conducted on a CRT monitor inside a dark room. Subjects had to adjust the color of part of the Mondrian by navigating within CIELab space using a gamepad. To select the colors to be used as reference, subjects did a preliminary session (*reference* session) where they were asked to produce the most representative colors from a list (red, pink, purple, blue, green, yellow, orange, brown and grey) on an achromatic Mondrian. *Regular* sessions were conducted in a similar fashion, except that subjects were asked to reproduce the colors recorded in the *reference* session. After training, each subject did 3 reference sessions and 11 regular sessions (see diagram) adjusting 5 times each of the nine colors (45 runs) over two weeks.

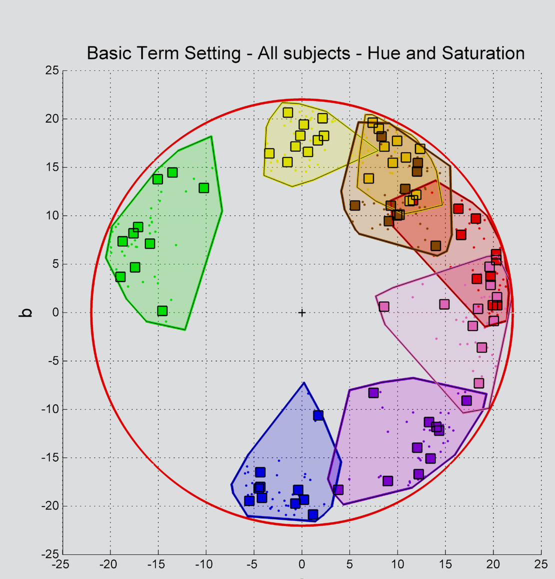
- **Subjects:** 10 color normal subjects.
- **Backgrounds:** *Focal*, *Intermediate* (half way between focals) and *Achromatic*.
- **Illuminants:** D65, Greenish, yellowish.

Paradigm Validation

Representative focals

The figure below shows results for the *reference* session. Each point represents a subject's selection. The colored areas shows a the variability of all responses.



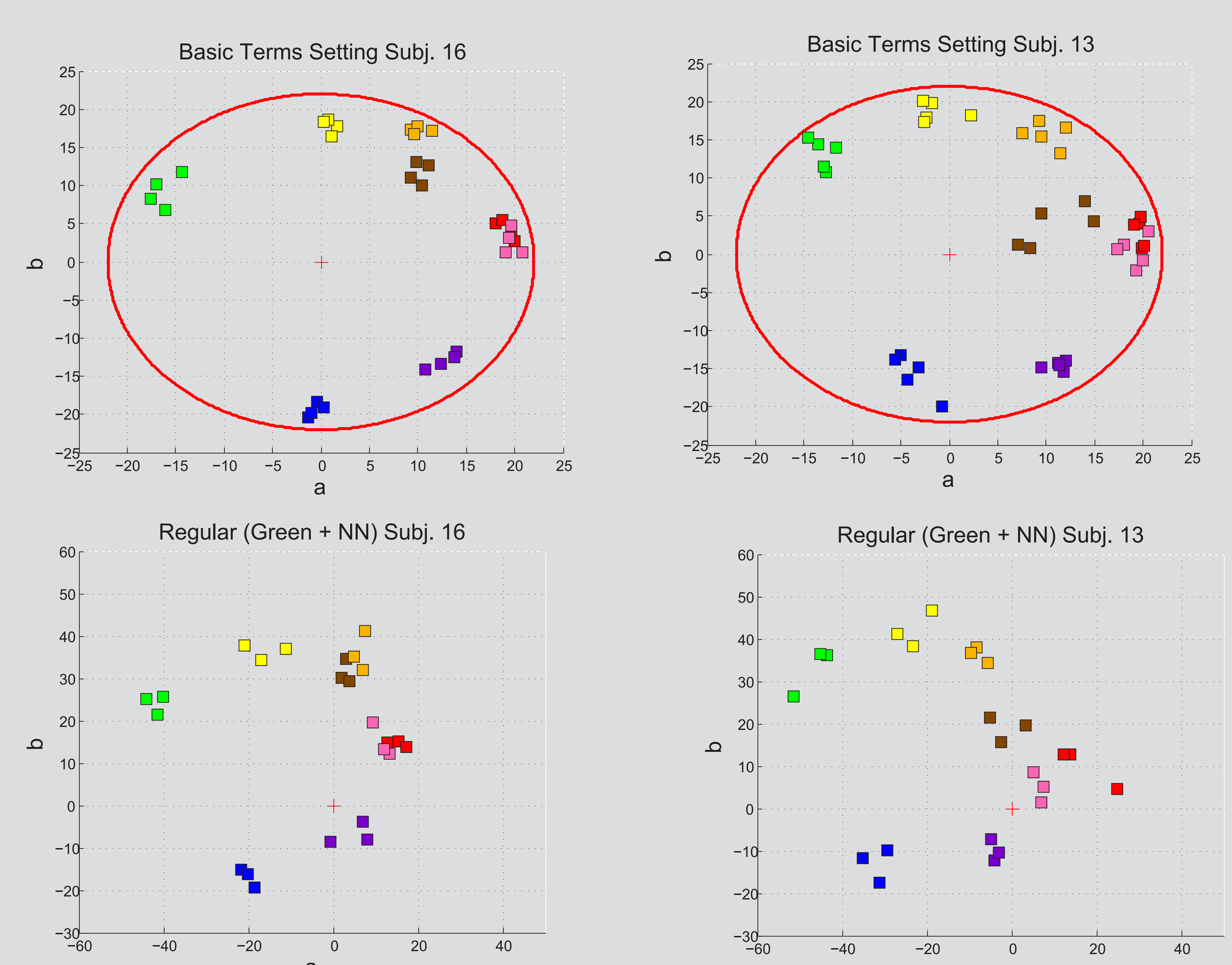


Experimental Error

The right figure shows a comparison of the standard deviation across subjects for all experiments discriminated for all 3 CIELab dimensions.

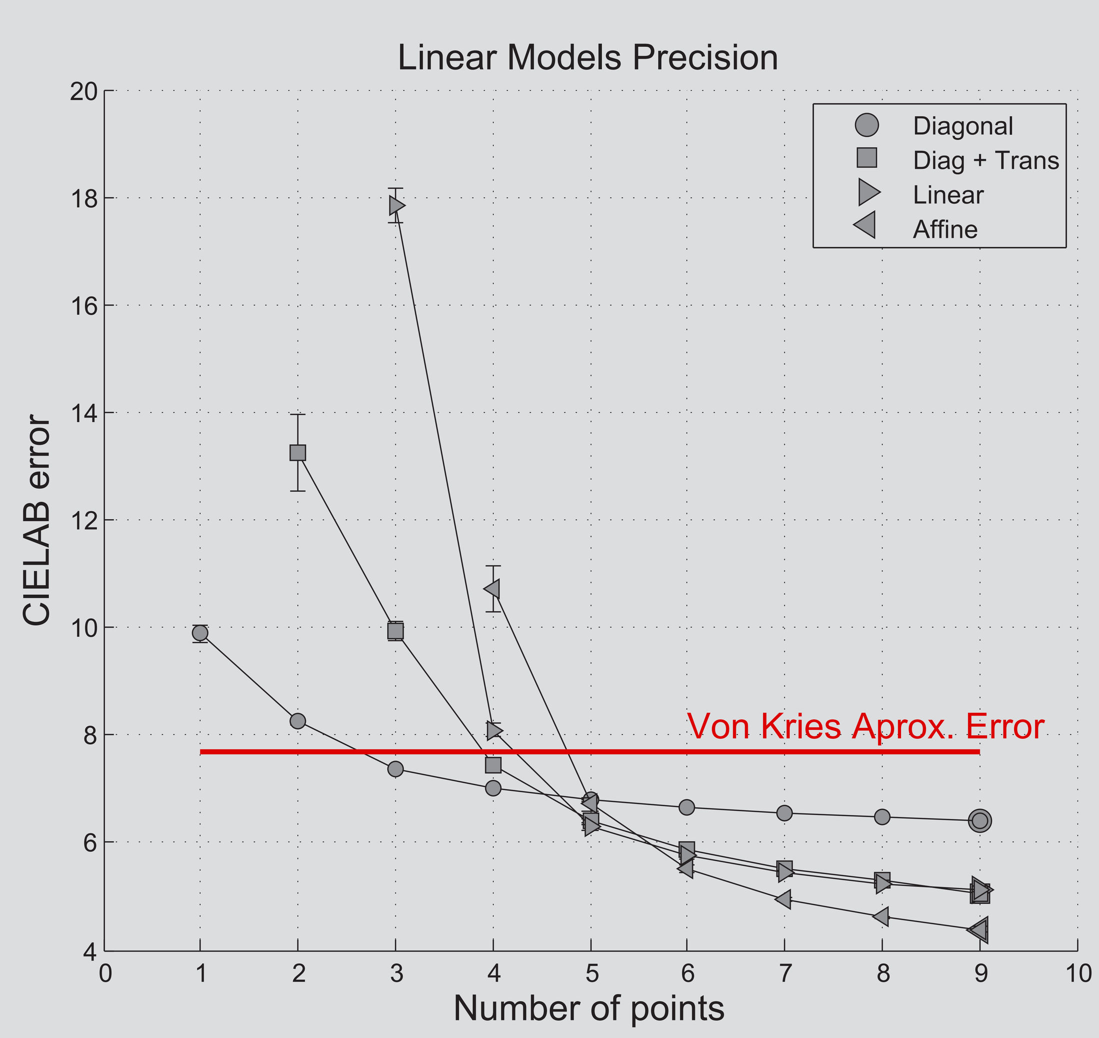
Do subjects produce the same colors over time?

A "memory test" was conducted three times throughout the experiment to check if subjects were able to reproduce the same colors over time. The results were confirmed quantitatively. Figure below shows a summary of how the color memory uncertainty is distributed for each ot the three CIELab dimensions.



Linear Models Precision

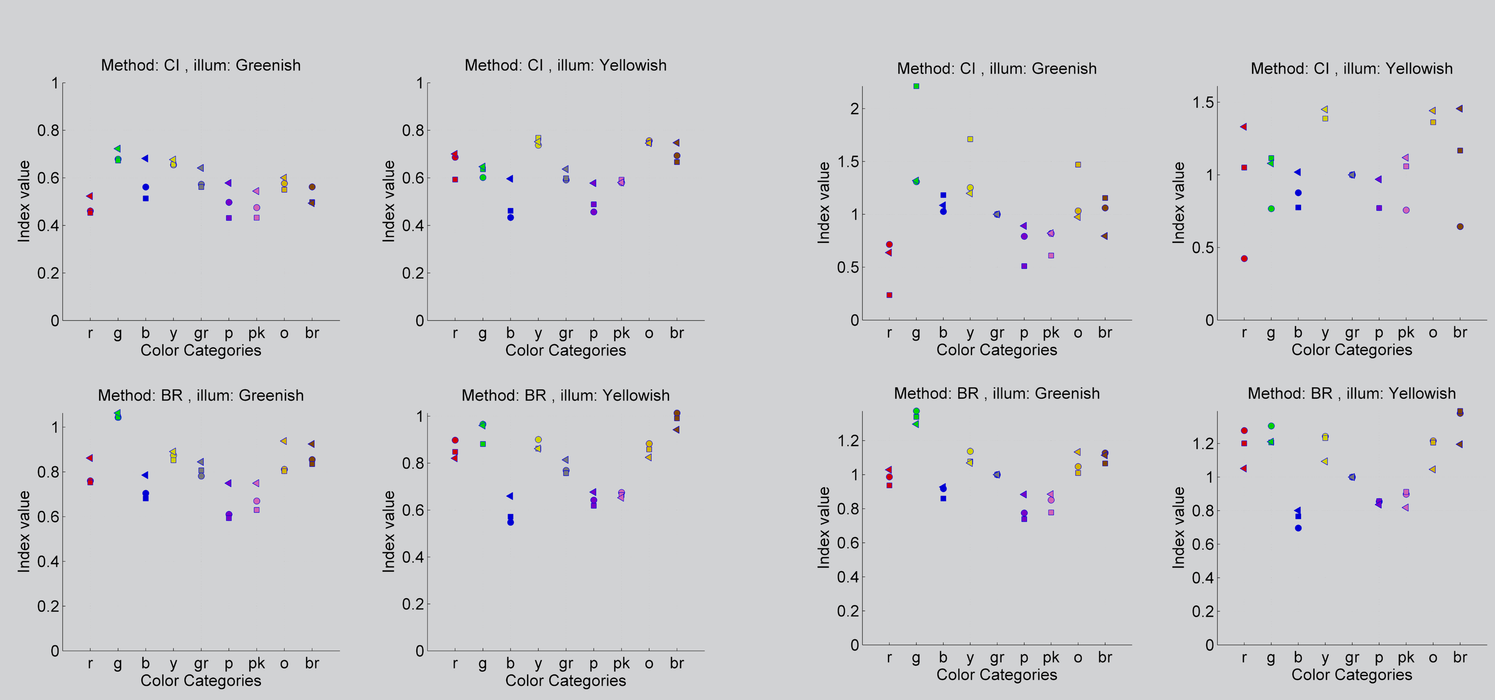
To model color constancy we fitted a linear model of increasing complexity with the psychological data. Figure below illustrates how the precision of this model improves when the number of focal colors used as input increases.



Paradigm Application

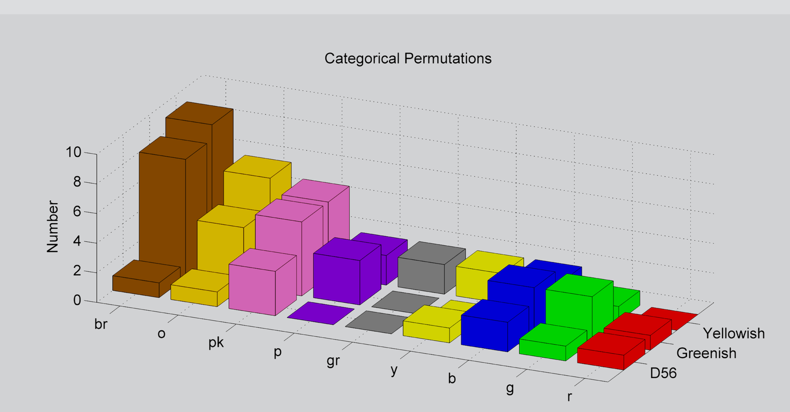
Color Constancy Index

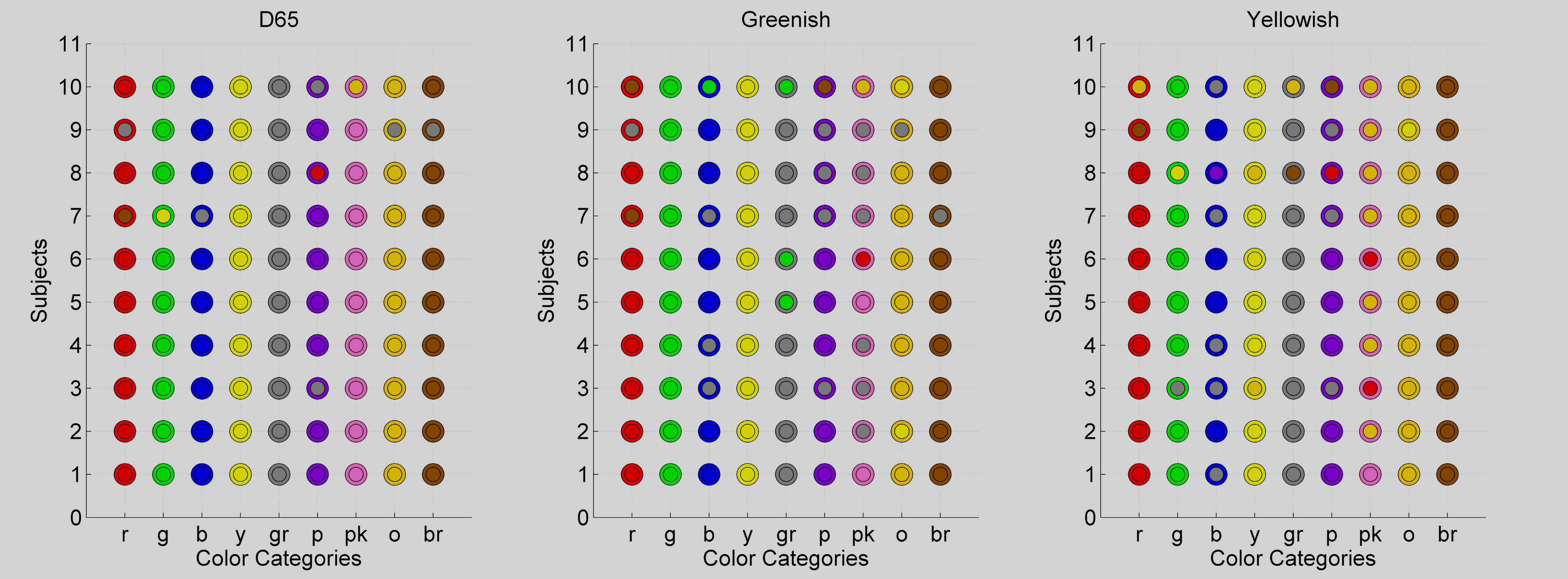
- There are no relevant differences among backgrounds over all illuminants.
- Tendency for the achromatic background (D65) to have higher mean values.
- Differences in CI values among color categories: Orange, brown, yellow and green focals have larger constancy indexs than grey in all cases.



Categorical Changes

The figure below summarizes perceptual changes in category for all subjects, colors and illuminants. The larger disk color indicates the reference category name and the smaller disk the category after illuminant adaptation.





Conclusions

- Our paradigm makes use of the best points of several successful paradigms while trying to avoid their drawbacks.
- The color constancy index for some colors is smaller than for the achromatic locus.
- In some of the cases we have measured category changes in the focals.

REFERENCES

- Berlin, B. and P. Kay (1969). Basic color terms; their universality and evolution.
- Foster, D. H. (2010). "Color constancy." Vision Research.
- Shevell, S. K. and F. A. Kingdom (2008). "Color in complex scenes."
- Brainard, D. H., W. A. Brunt, et al. (1997). "Color constancy in the nearly natural image .

Acknowledgements
This work has been partially supported by Project TIN2007-64577 , Project RYC-2007-00484 and Project Consolider-Ingenio 2010-CSD2007-00018 of the Spanish MEC.