Differences Between CRT Colors and Surface Reflectances

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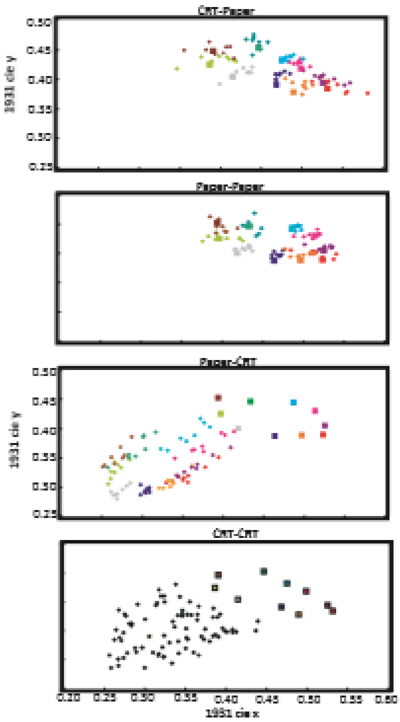
INTRODUCTION

Granzier et al (2009) found noticeable deviations when real papers had to be matched with a CRT. Hedrich and Bloj (2010) showed that there are also limitations to cross-media agreement in colour naming.
Here we investigate the factors that influence differences between matching with a CRT and matching with real papers.

EXPERIMENT 1

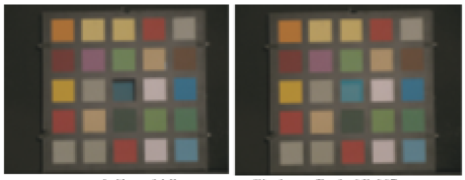
First we wanted to replicate the data of Granzier et al. (2009) with a few improvements. Subjects (n=8) saw either a real Munsell paper or an identical color on a CRT presented through a hole in a wall illuminated by a neutral lamp. It was perfectly obvious when a paper or when a color on a CRT was presented. Subjects matched 10 colors either with another CRT or with the Munsell book of colors. The Munsell book was illuminated by an identical neutral lamp. The 4 exp. conditions were tested in seperate sessions presented in random order between subjects. Subjects matched both color and luminance.



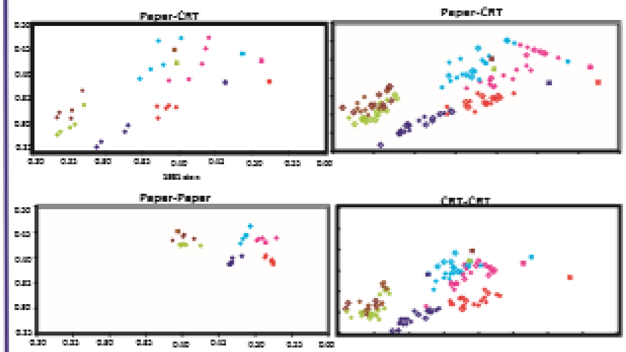
Squares represent perfect matches. Dots show average color matches for each subject. Each color represents a different reference color. For perfect matches all dots of a certain colour should lie on top of the square of that color. The names on the top of each panel shows how the reference color was presented, the second name shows how the matching was done. Subjects were poor in color matching when they had to use the CRT to make the matches (bottom 2 graphs), irrespect of the media in which the reference colors were presented (Paper versus CRT).

EXPERIMENT 2

In exp. 1, subjects knew that they were either looking at emitted or reflected light. In exp. 2, we tried to conceal this fact and tested whether the bias in color matches is caused by a high-level cognitive factor. We presented the reference colors as part of an Mondrian display. We asked subjects (n=5) to guess whether they were looking at emitted or reflected light.



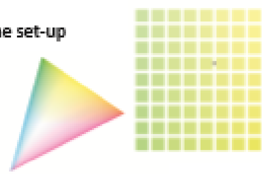
Is the middle square emitted or reflected light?



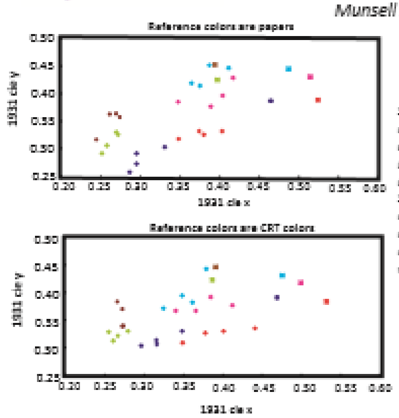
EXPERIMENT 3

There are a few low-level differences between the 'CRT matching task' and matching with the Munsell book. In exp. 3 (n=4) we tested whether some of these low-level factors could explain the results of the first experiment.

The set-up



Subjects matched emitted or reflected light with another CRT. Now, they had an overview of the whole color space to choose from. Secondly, they could compare chips in this selected color space, like the procedure when using the Munsell book.



Squares represent perfect matches. Dots show average color matches for each subject. Each color represents a different reference color. Subjects were poor in color matching when using this CRT matching task irrespect of the media in which the reference colors were presented.

CONCLUSIONS

There seems to be a fundamental difference between matching with a CRT and matching with the Munsell book that cannot be explained by low-level factors studied thus far. This bias in color matches is also independent of whether the subject 'knows' of whether he/she is dealing with emitted or reflected light. The way the reference color is embedded into the scene does not seem to be a key factor either.

References

- Granzier, J.J.M., Brenner, E, & Smeets, J.B.J. (2009) Do people match surface reflectance fundamentally differently than they match emitted light? Vision Research, 49, 702-707.
- Hedrich, M., & Bloj, M (2010). Basic colour names for 2-D samples: effects of presentation media and illuminants. Ophthalmic and Physiological Optics, 30(5), 638-645.