Illumination discrimination depends on scene surface ensemble

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Introduction

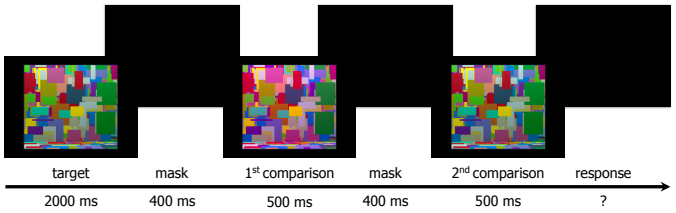
How good are humans at detecting changes in illumination?

Pearce et al. (2014) studied illumination discrimination along four chromatic directions — the daylight locus (blue, yellow) and orthogonal to it (red, green).

For the set of test scenes they used, sensitivity to bluish changes in illumination was significantly lower than for other chromatic directions.

Subject is shown a scene illuminated by a target light, followed by two scenes each illuminated by a comparison light.

Task: Which of the two comparison lights is most like the target light?



Target Illumination: D67

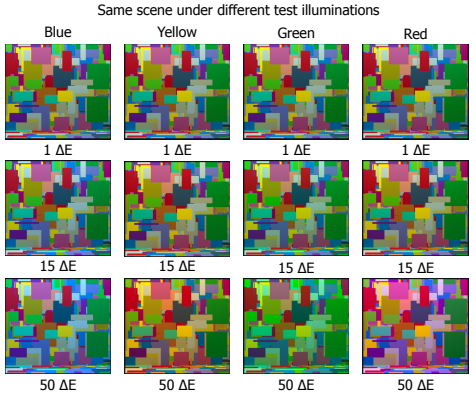
Test Illumination:

4 chromatic directions
- blue, yellow
- red, green

50 steps per direction

Equally spaced in CIE L*u*v*

Equiluminant



The question

Does sensitivity to illumination changes in different chromatic directions depend on the surfaces in the scene?

The intuition

Changing the surface reflectances in the scene will differentially affect the information available for detecting illumination changes in different chromatic directions.

The test

Measure illumination discrimination thresholds for scenes containing different surfaces.

Method

3 test scenes
- same 16 surface reflectances
- different sampling and distribution

4 illumination directions

Stimuli rendered via RenderToolbox3 and displayed stereoscopically

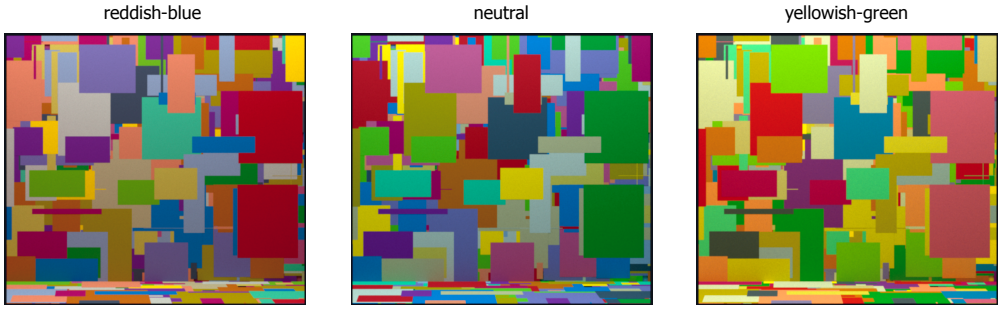
12 interleaved staircases per session (3 staircases x 4 illumination directions)

10 subjects

6 sessions (2 sessions x 3 test scenes)

Threshold: 70.71% correct discrimination

Three test scenes, each rendered under target illumination (D67)



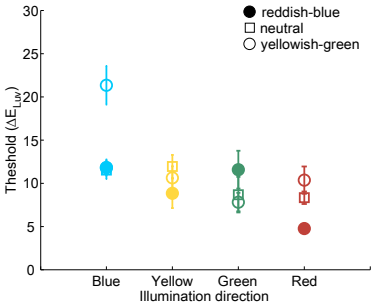
Results

Sensitivity to illumination changes varies with the surfaces in the scene.

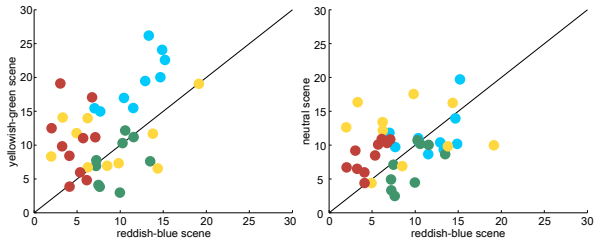
For red illumination change: significantly lower thresholds for the reddish-blue scene.

For blue illumination change: significantly higher thresholds for the yellowish-green scene.

For both the reddish-blue and yellowish-green scenes, thresholds for blue illumination changes were significantly higher than for red.



Main differences in illumination-discrimination thresholds for the different test scenes hold across observers.



Conclusions

Discriminability of illumination changes in different chromatic directions depends on the surfaces in the scene.

Next step: characterize how illumination discrimination varies with variation in scene surface ensemble.

One possible direction: model our effects via an ideal observer calculation.

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