Colour Vision and R

Dr Jeremiah MF Kelly
The University of Manchester
jeremiah.kelly@manchester.ac.uk

Outline

- Background
- Lightness and Colour Constancy
- Influence of Daylight
- The role of R
- Questions

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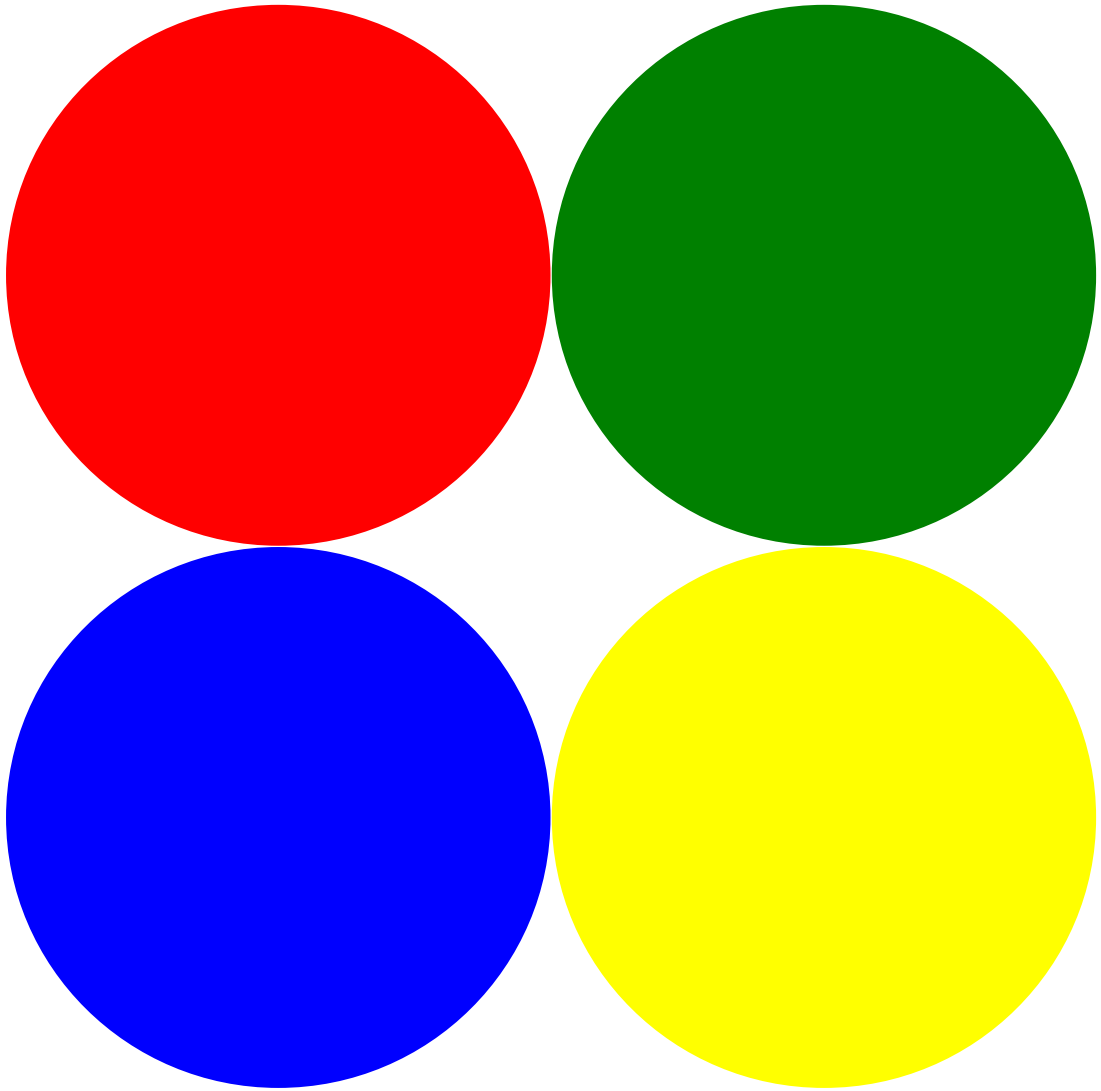
Colour

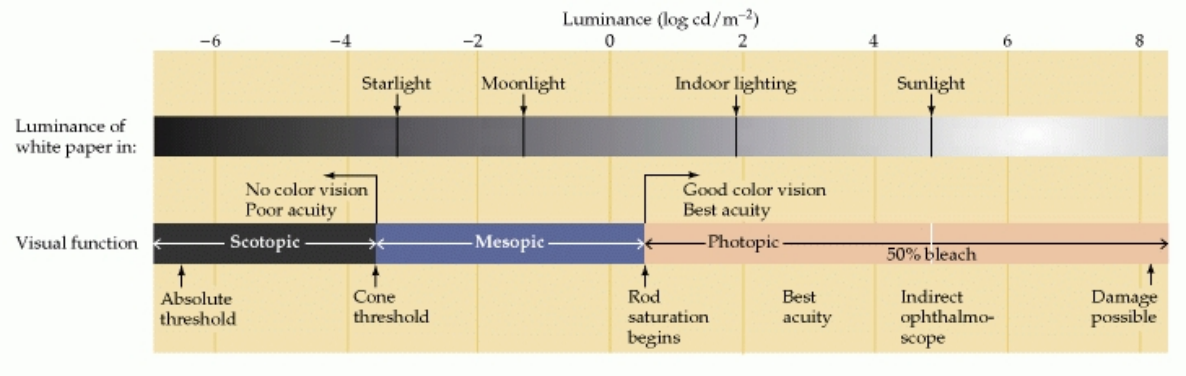


Colour Vision

- Perception of light reflected from a surface
- Depends upon
  - Incident light
    - Dominant wavelength(s) or Colour Temperature
    - Intensity (Illuminance / Irradiance)
  - Reflectance of the Surface
    - Absorbance and Luminance/Radiance
    - Specular or Diffuse
  - Sensory Mechanism

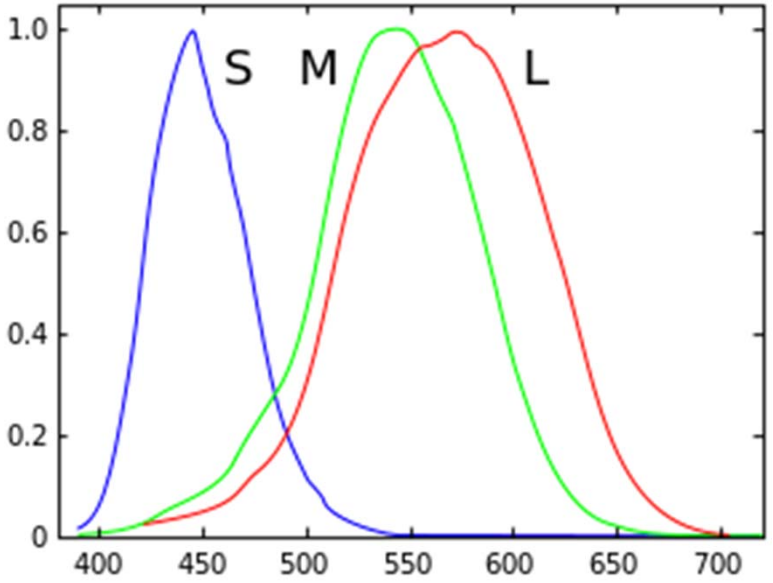
Light

- Part of the electromagnetic spectrum
  - Characteristics: wavelength, intensity…
- Many different models
  - Wave
    - Front/train – interference, thin films
  - Rays
    - Geometrical – lens and mirror design
  - Quanta
    - Photo-electrics
  - …



Physiology

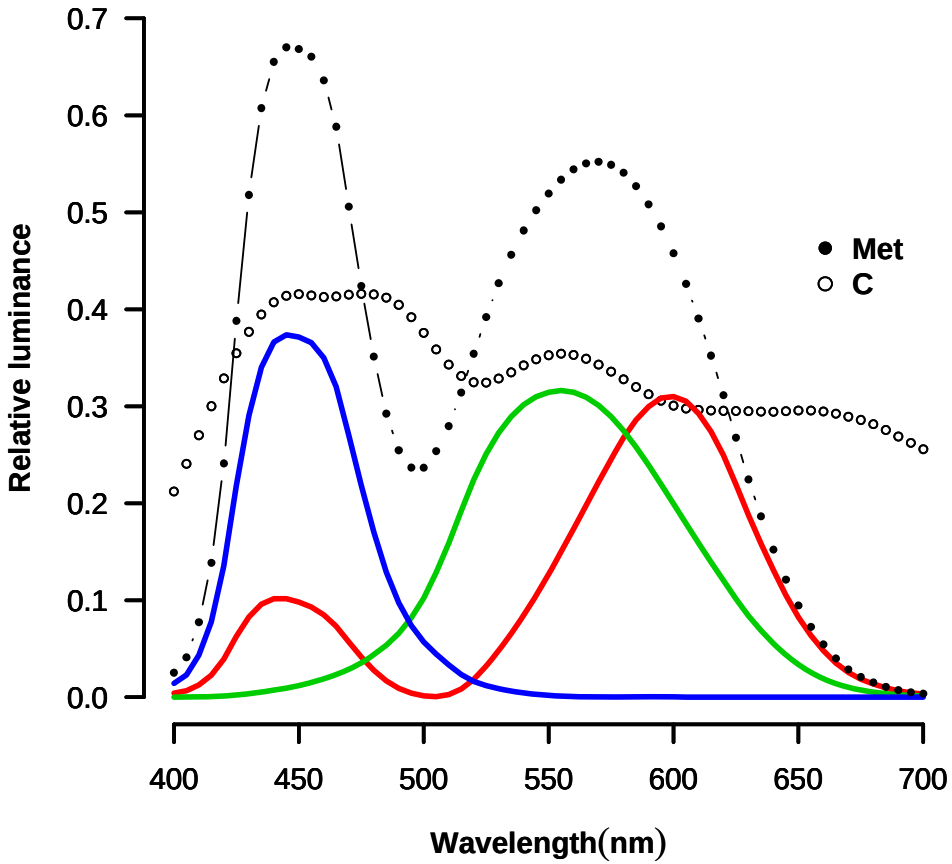
- Sensors
  - Cones
    - Long
    - Medium
    - Short
  - Rods, IPRGC…
- Model
  - Ψ <- psyche{ $f(L_\Phi, M_\Phi, S_\Phi)$*(top down) }



https://en.wikipedia.org/wiki/LMS_color_space#/media/File:Cones_SMJ2_E.svg

Physics

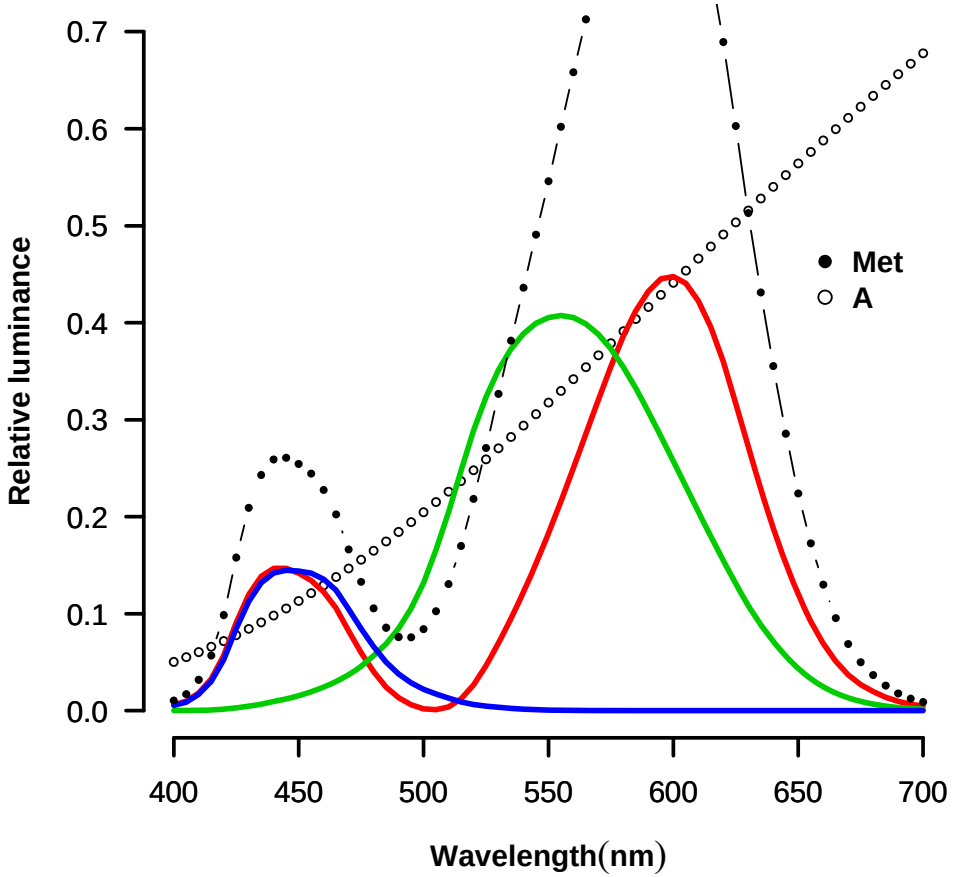
- Spectrum
  - CMF
  - MASS::ginv
  - Metameric
    - 0.310 0.316 0.37



- Model
  - Φ <- Sensor(Light * Object) + N(0, σ)

Colour Space

- Perceptual
  - Luv
  - Lab
- Absolute
  - HSV (Munsell)
  - RGB
  - Pantone
  - Illuminant A
    - 0.447 0.407 0.14



- Ψ <- psyche{ $f(L_\Phi, M_\Phi, S_\Phi)$*(top down) }

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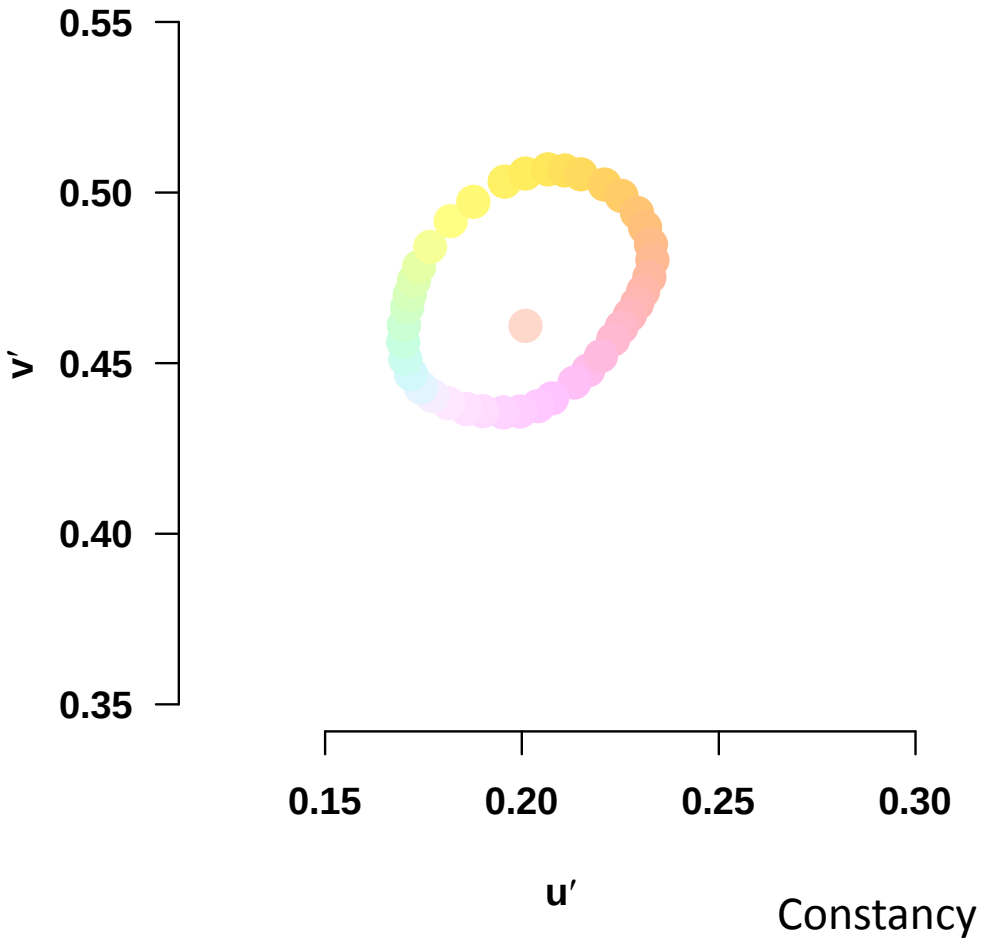
Method

- Create illuminants from the XYZ using CMF
- Create a TFM
- Map objects under C to test illuminant
- Convert to Luv

Constancy

- What happens to objects viewed under differing illuminants
- Munsell chips
  - 40 isoluminant under ‘C’
  - Uniformly spaced
- Percept unchanged



Constancy

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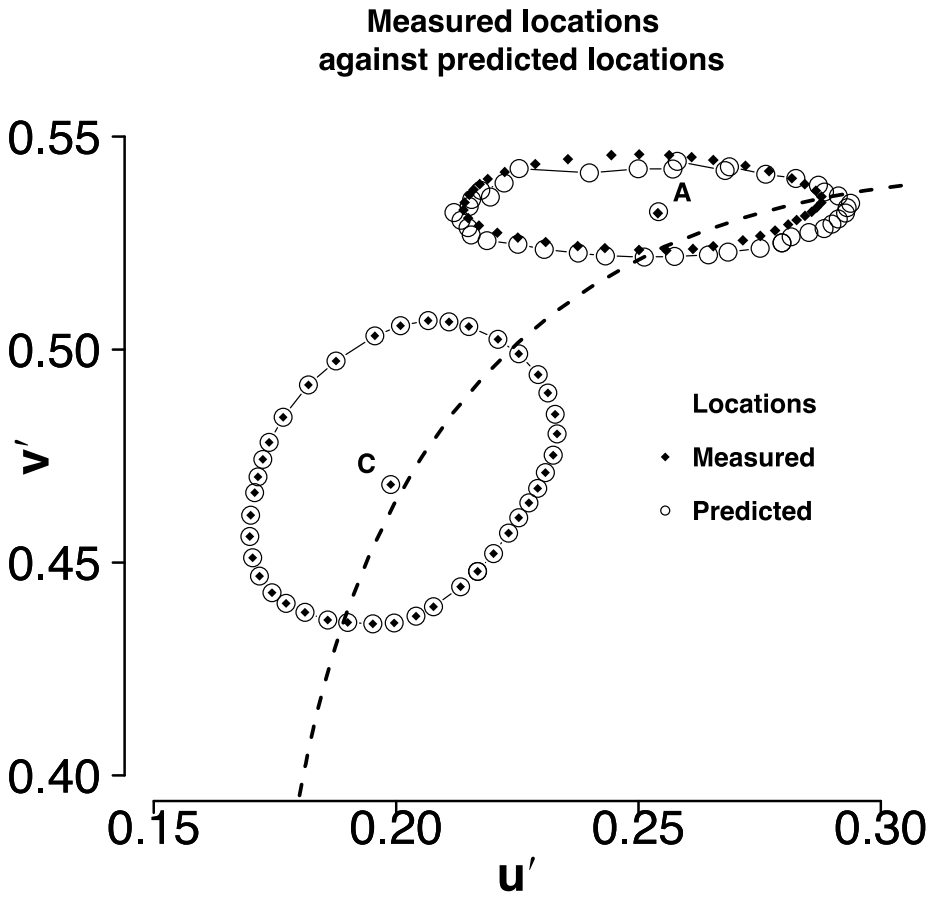
Accuracy of model



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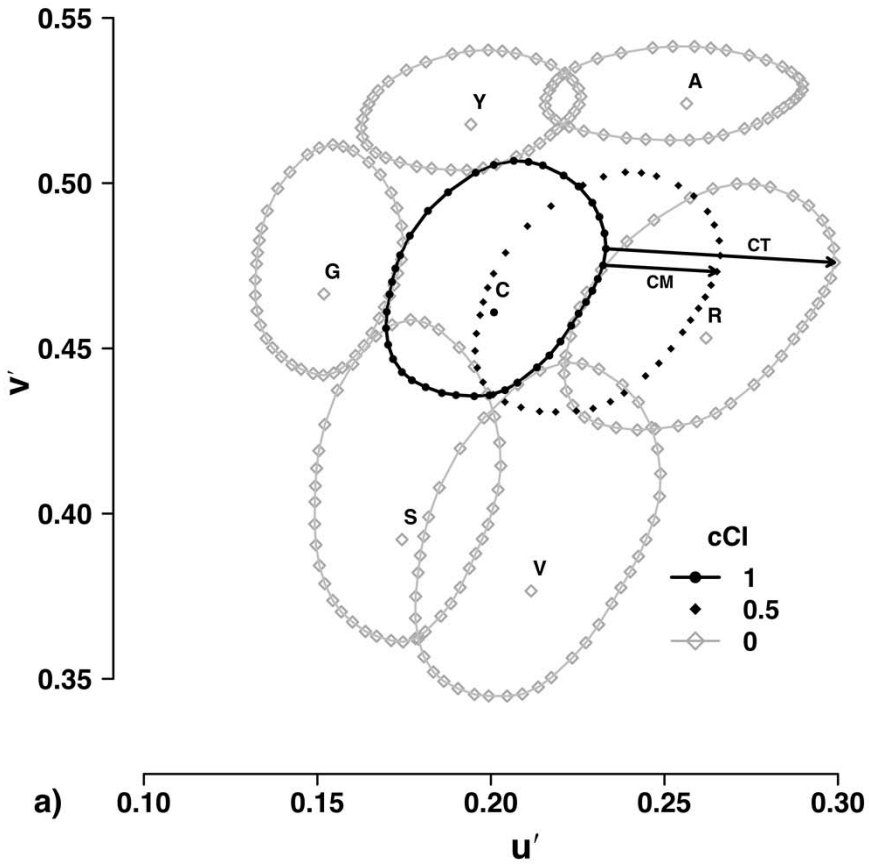
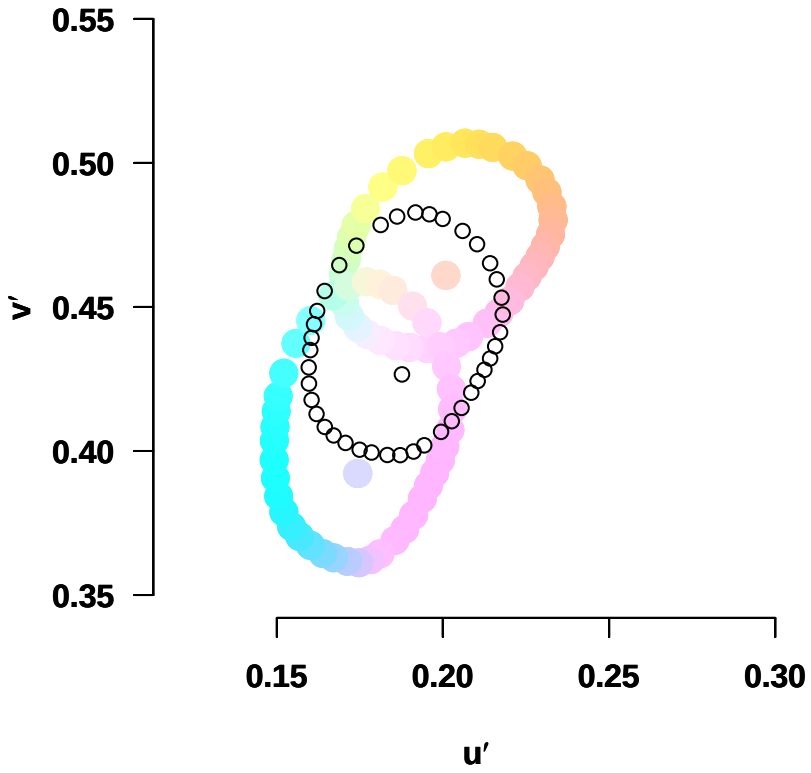
Constancy

Several Illuminants



Colour Constancy



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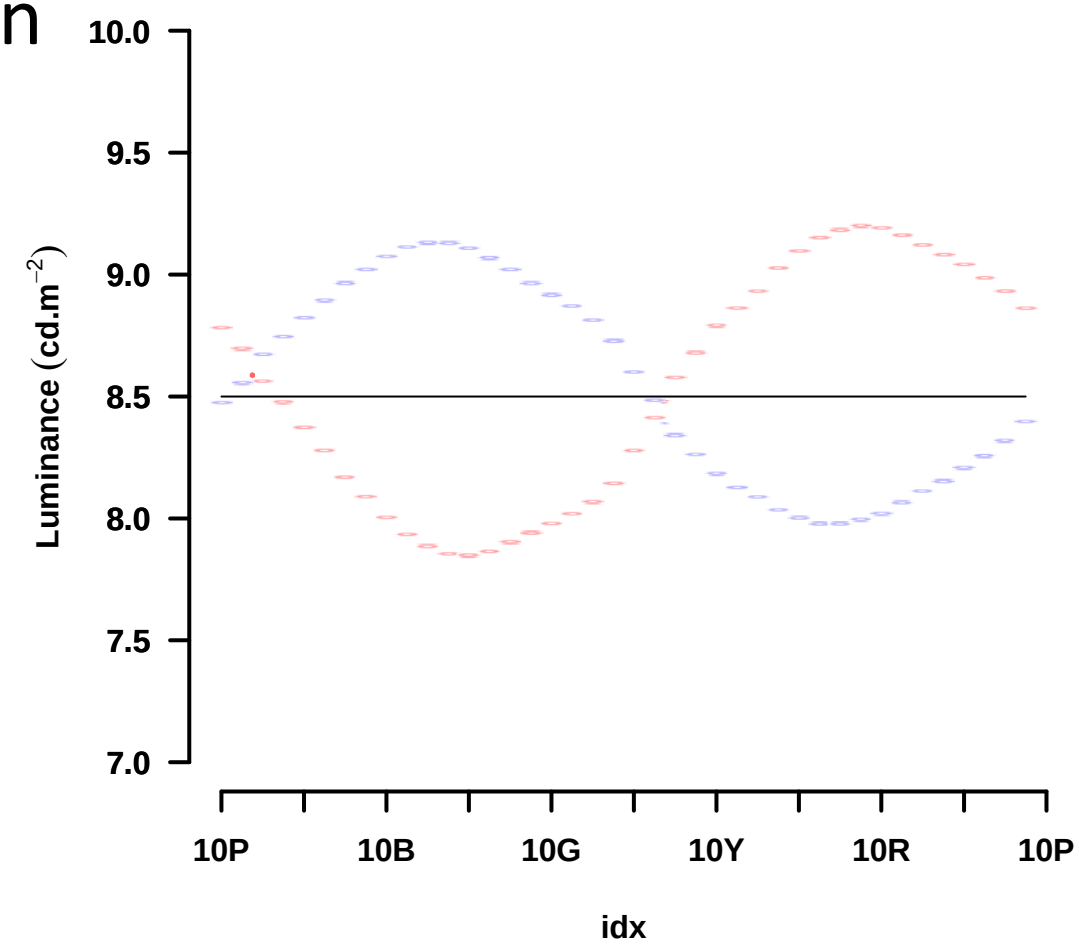
Lightness Constancy

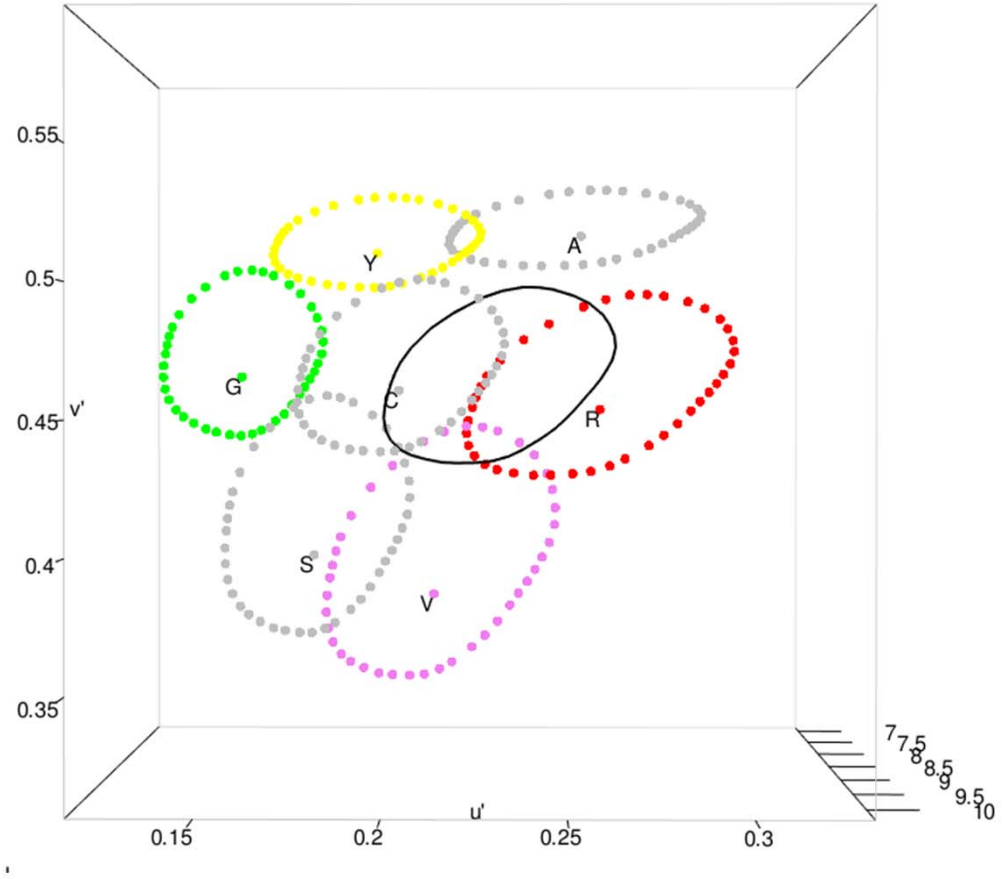
- Is it a function of CC?
- Vice versa



Package ‘rgl’

- Show script
  - ‘Interactive_Luv’

rgl 3d plot



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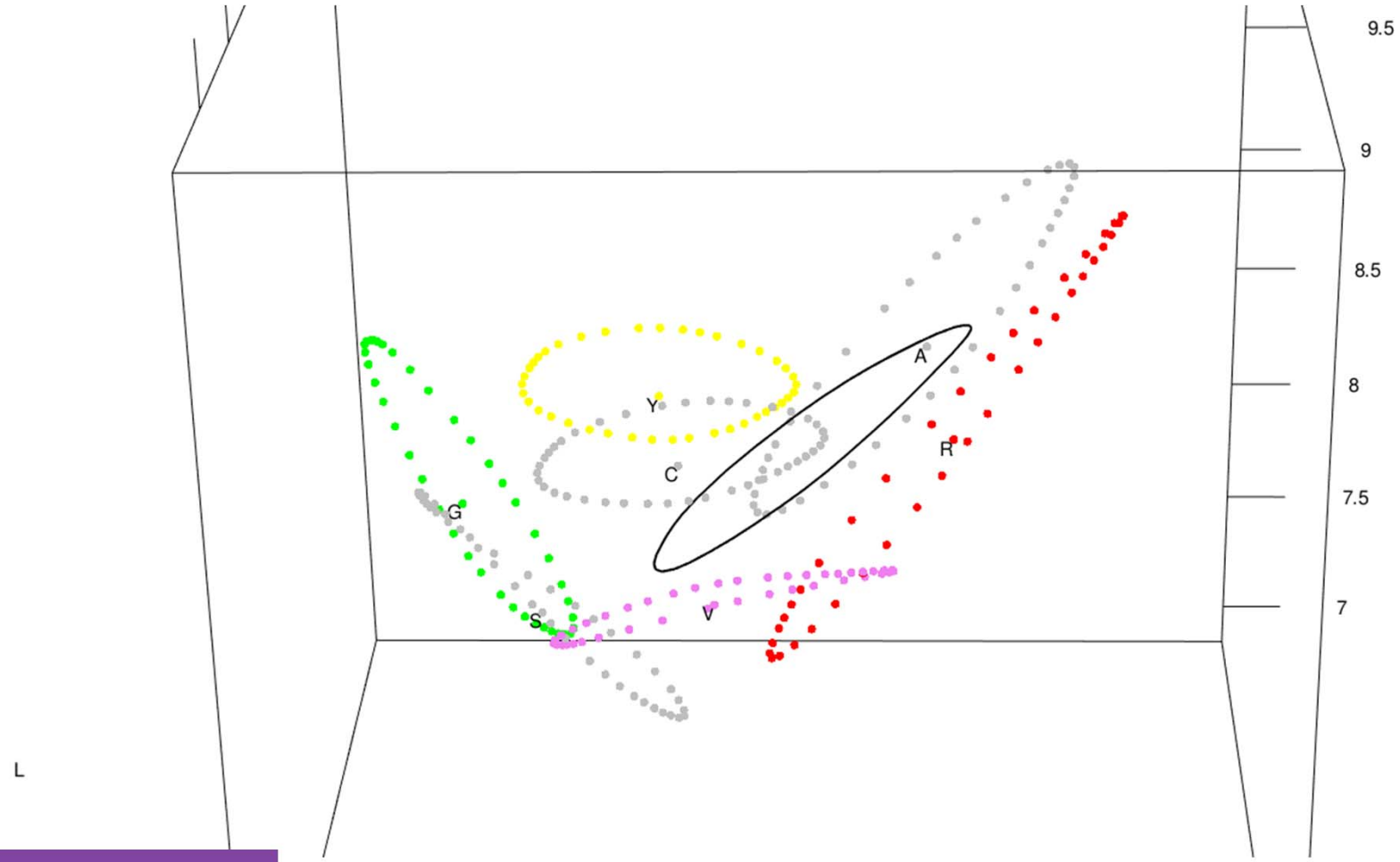
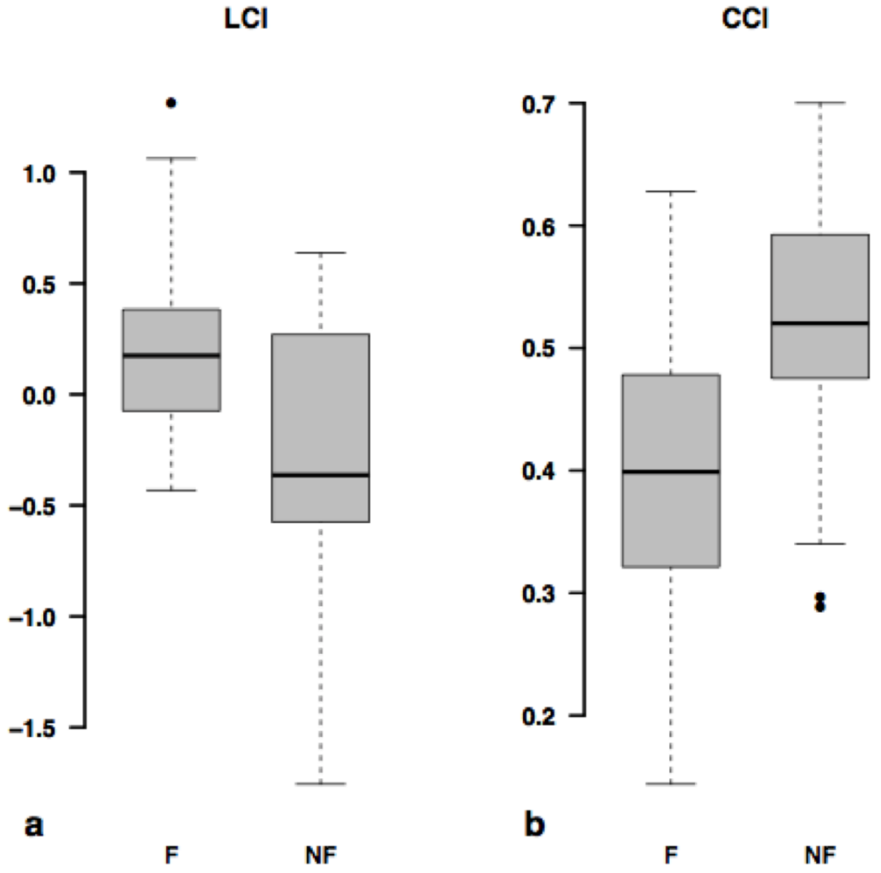
Constancy

rgl 3d plot2



Effect of Frame

- The geometry predicts that LC and CC are related



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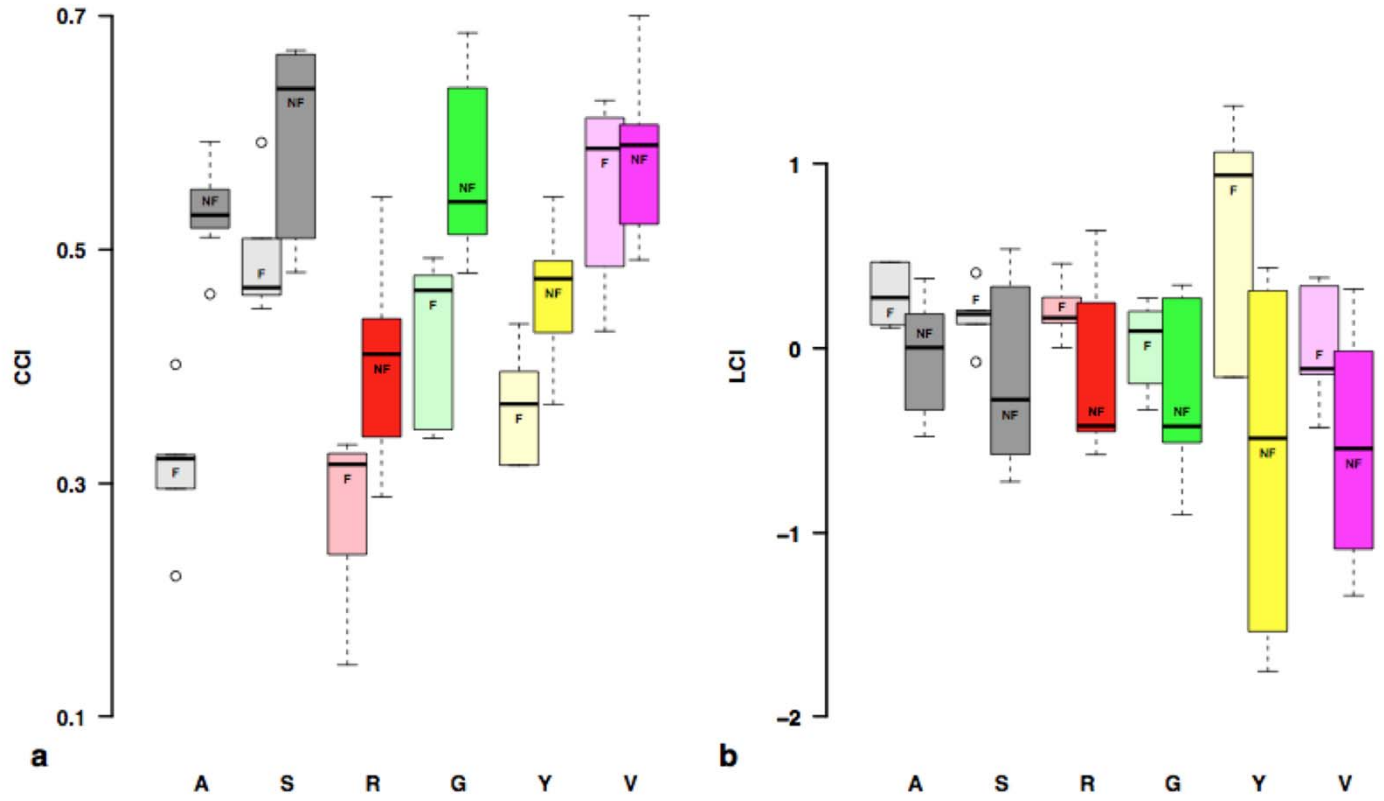
Effect of Frame



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Constancy

Conclusion

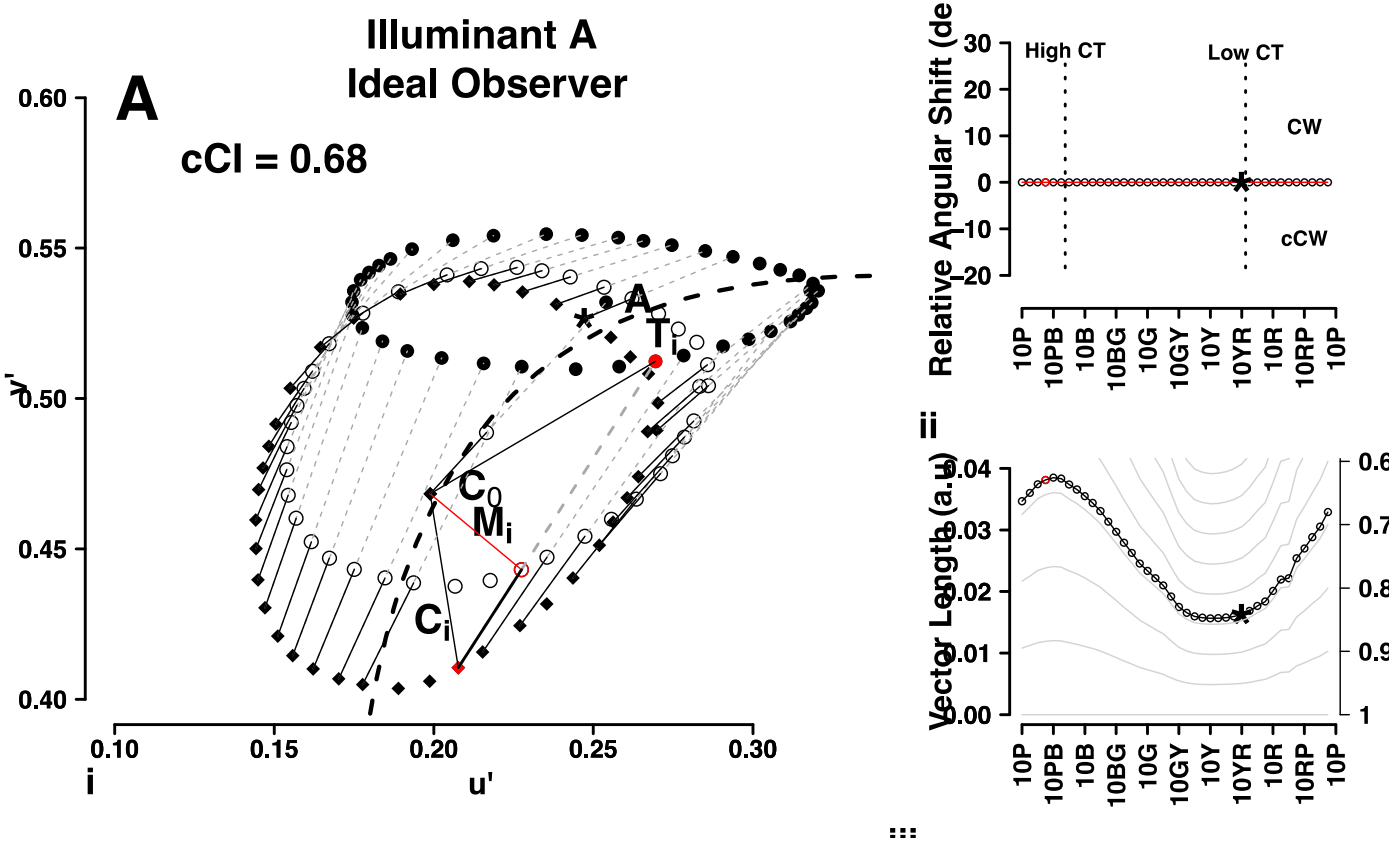
LCI is increased by the frame, perhaps it masks achromatic contrast.

CCI and LCI seem to be mediated by different mechanisms

The visual system somehow loses information about luminance and defaults to settings based only on chromaticity

Daylight

- Is it a real effect?



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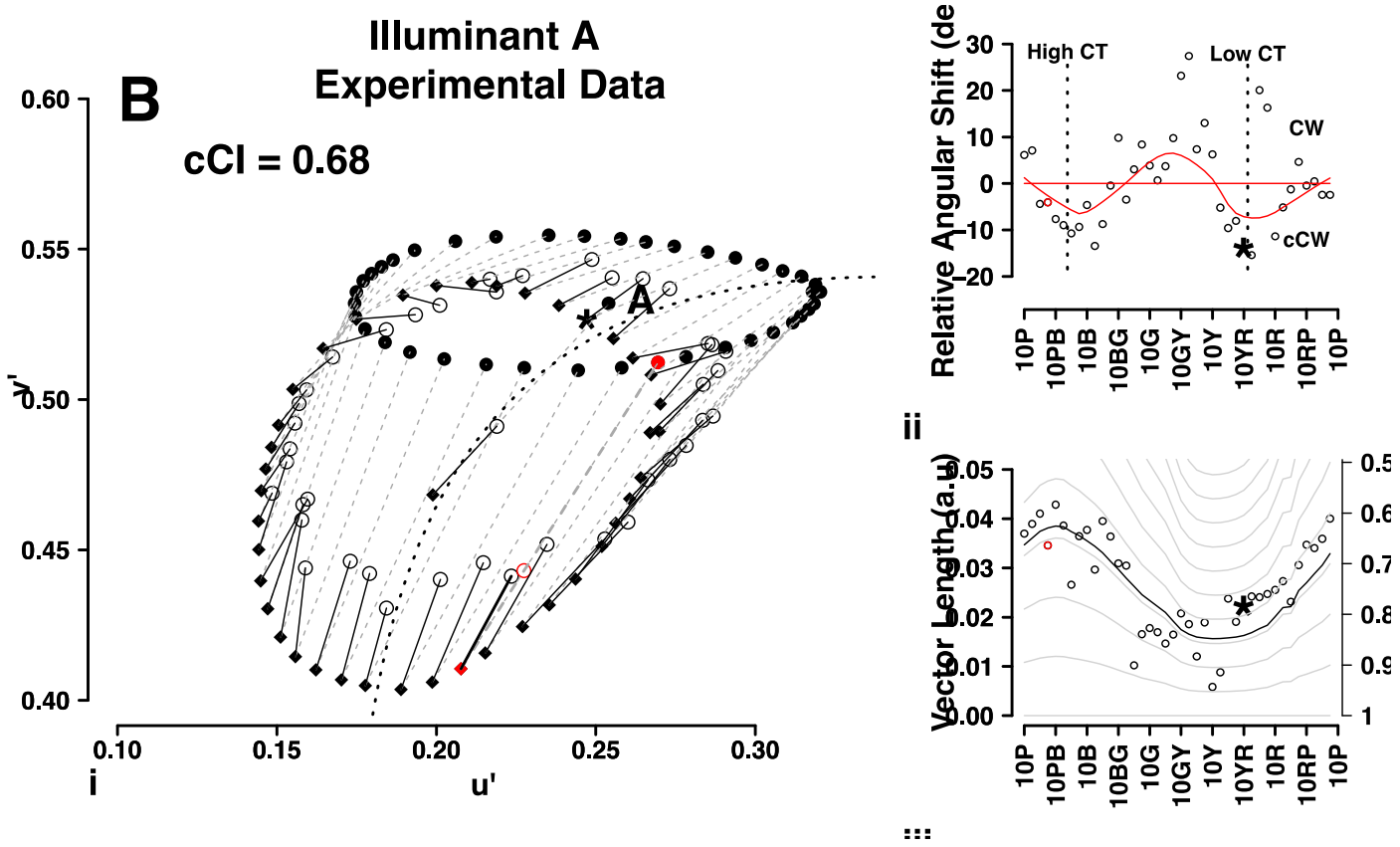
Daylight

- Locus effect



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Daylight

- CC varies by chip and is predicted by the model
- Hue shift a rotation
  - Not predicted by the model
  - Influenced by the Planckian Locus

R

- Started using R in 2011
  - Interactively on the console
  - Minimal function writing
- Soon learned
    - Use functions
    - Replace loops with apply
    - Eventually found :: notation
    - ‘t()’ and %*%
- Repeatability
    - Dig
    - Build

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Thank you

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I. Murray, A. Daugirdiene, A. Panorgias, R. Stanikunas, J. Kulikowski, and J. Kelly. Lightness constancy and its link with cone contrast. JOSA A, 31(4):A350–A356, 2014.
A. Daugirdiene, J. Kulikowski, I. Murray, and J. Kelly. Test illuminant location with respect to the planckian locus affects chromaticity shifts of real Munsell chips. JOSA, 33(3), 2016.