How the S, M and L cones contribute to motion luminance assessed using minimum motion

Conference Paper · July 2013

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How the S, M and L Cones contribute to motion-luminance assessed using minimum motion

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Rationale

• We investigate basic properties of motion-luminance as measured by the minimum motion paradigm (Anstis & Cavanagh 1983). Specifically, we ask:

1. Do all lights equiluminant to a given achromatic light actually lie (as generally assumed) in a plane in cone activation space?
1. Is motion-luminance (the direction normal to the best approximation to the equiluminant plane) invariant with respect to the intensity of the achromatic light used to generate the plane?

Method

• For each of three achromatic intensities *G* we used the minimum motion method (Fig. 1) to derive 20 lights equiluminant to *G* varying in hue and each of maximum achievable saturation on our display device.

Task

•A staircase procedure adjusted the RGB parameters of the color until the candidate hue would appear to be moving to the either direction equally often (Fig. 1).

•We considered such light motion-equiluminant with the background.

• Typically, a light that was motion-equiluminant with the background gray was found in 50 trails.

Axis

Each cone axs is orthonormalized: $B1=S/|S|$ $B2=(L+M)^{\wedge B1}$ $B3=(L-M)^{\wedge B1, \wedge B2}$

Fig. 5. Results: Weights of the 3 cone types and of 3 orthonormal axes for equiluminant-motion colors in three gray backgrounds of different intensities

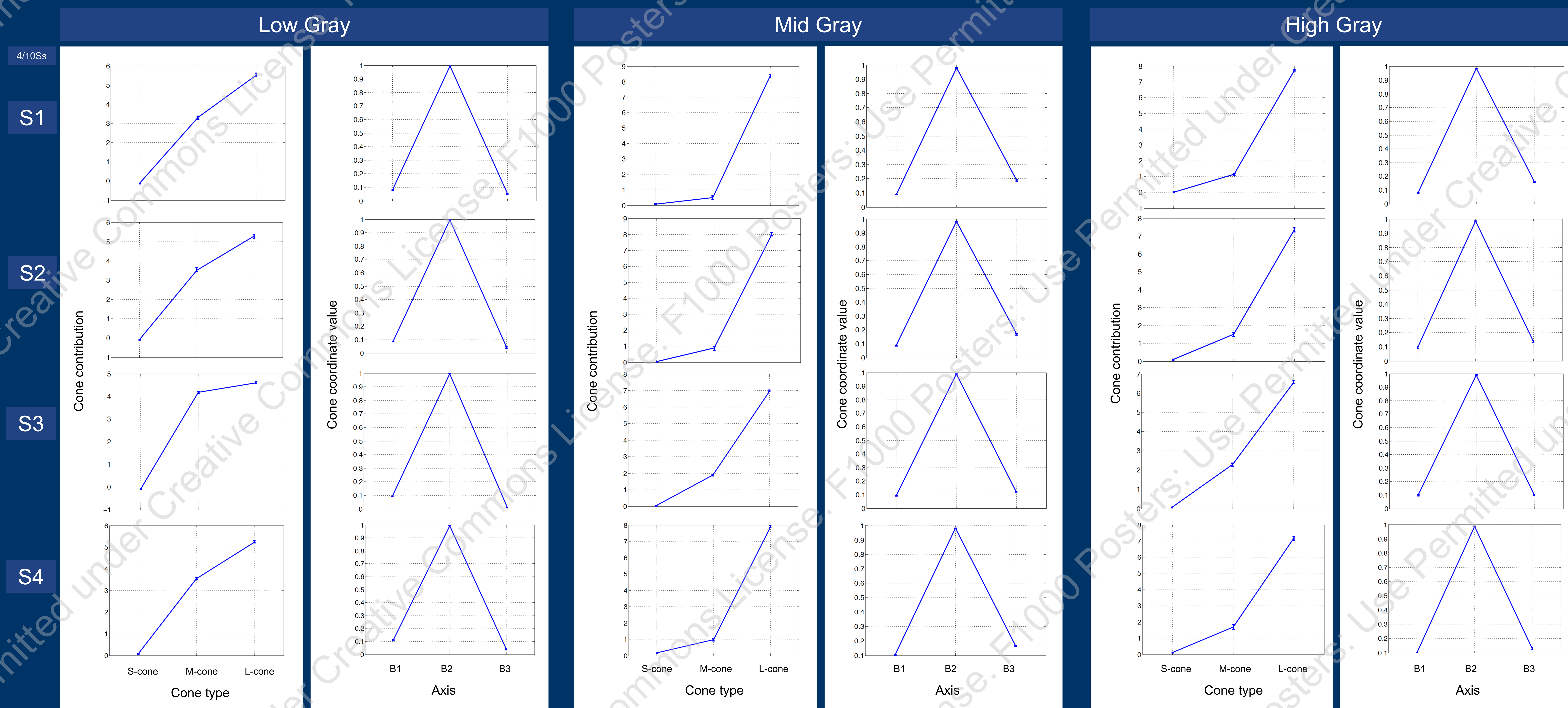


Fig. 1. Stimulus (Example)

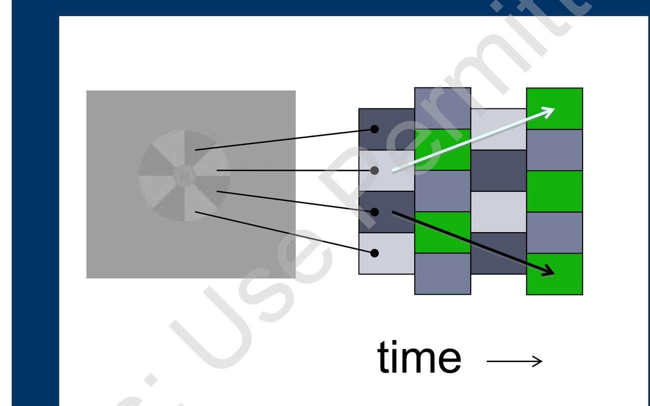


Fig. 2. Normalized spectral sensitivity of S, M, L cones

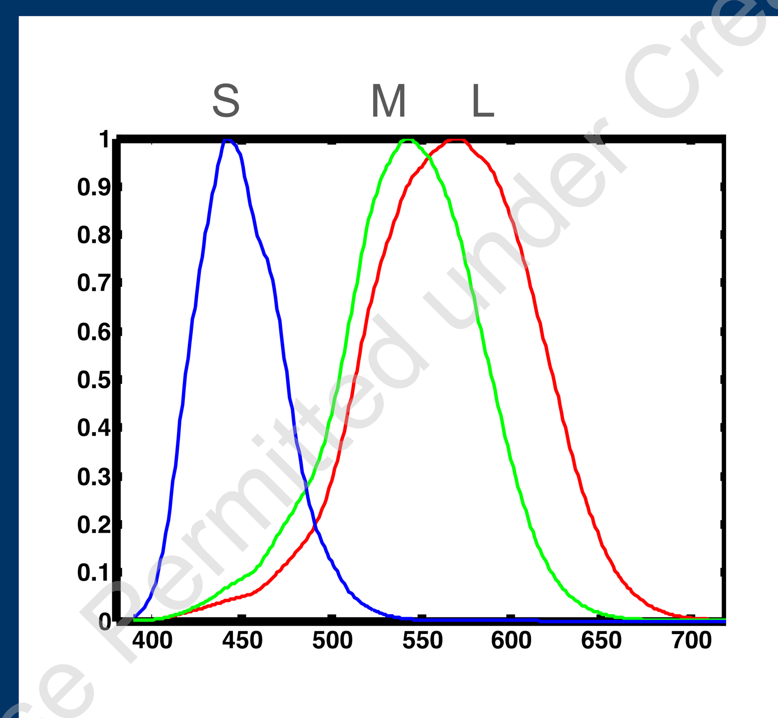


Fig. 2. Orthonormal S, L+M, L-M axes

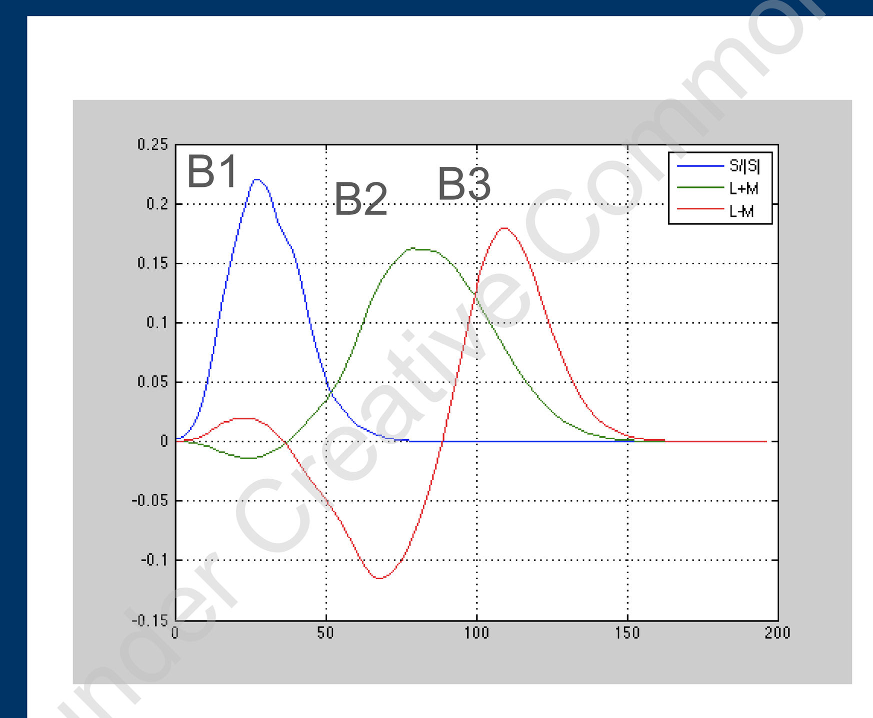


Fig. 3. Motion-equiluminant lights

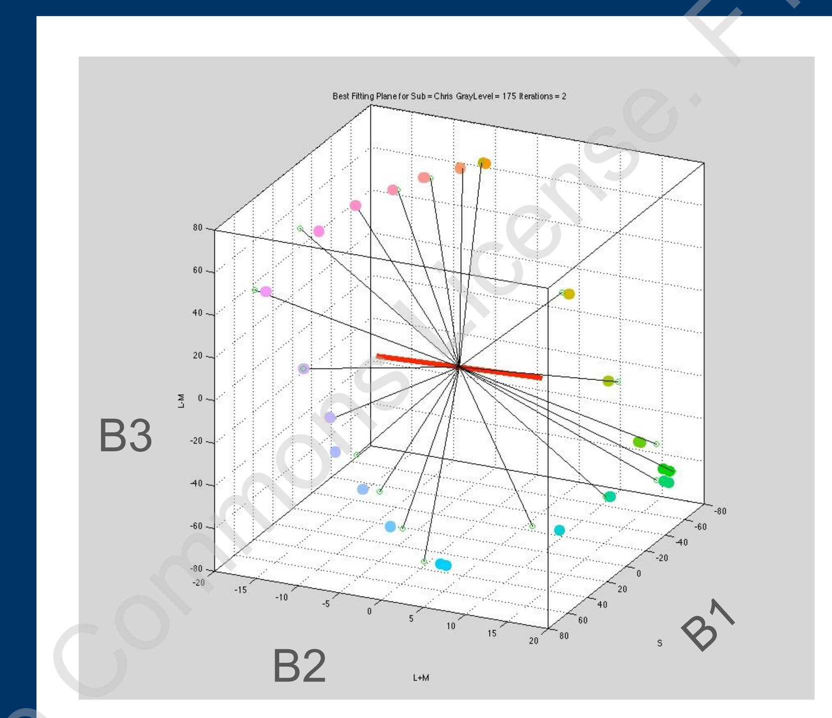
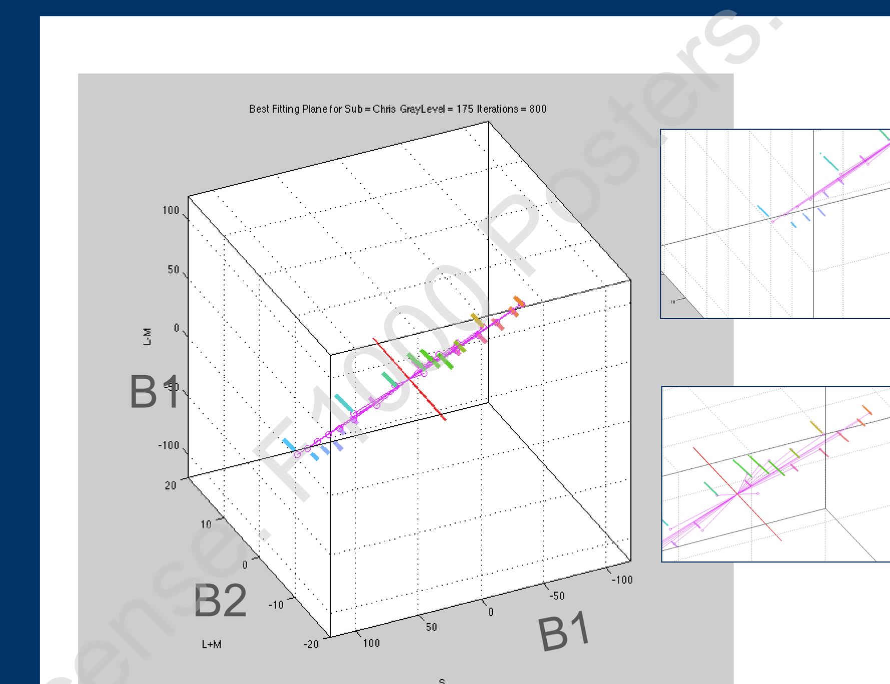


Fig. 4. Best fitting plane



Summary

1. Sets of lights equiluminant to a given achromatic light deviate slightly (but in many cases significantly) from planarity when projected into cone excitation space.

1. As the intensity of the achromatic light used to generate the equiluminant plane is increased, the relative contribution to luminance (as determined by the minimum motion method) of the L-cones vs. the M-cones increases dramatically, for all participants tested thus far, with large individual differences.

2. Whereas photopic luminance as defined by CIE 1924 has a 2:1 long-to-medium cone ratio, photopic motion-luminance has a varying cone ratio depending on the background, dominated by long wavelength cones.

References

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Acknowledgements

This work was funded by NSF Award BCS-0843897 to CC and GS and a UC-Mexus Conacyt Award to CH

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VSS 2013