Color constancy across materials

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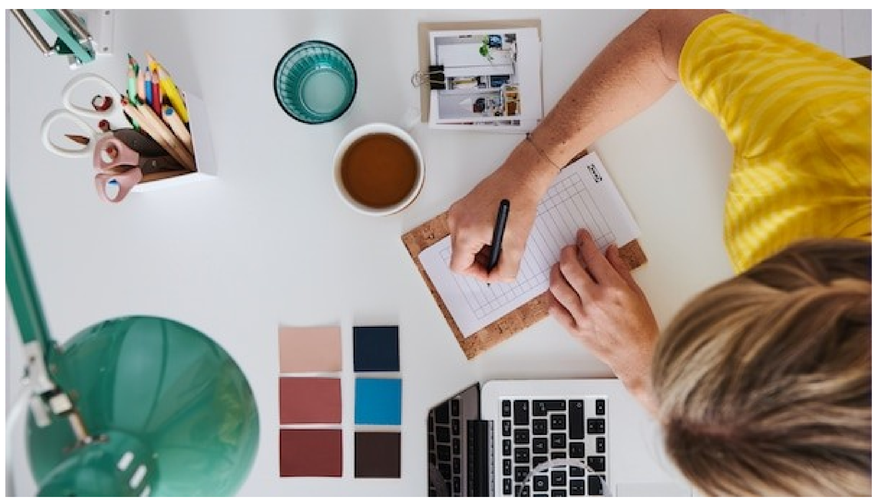
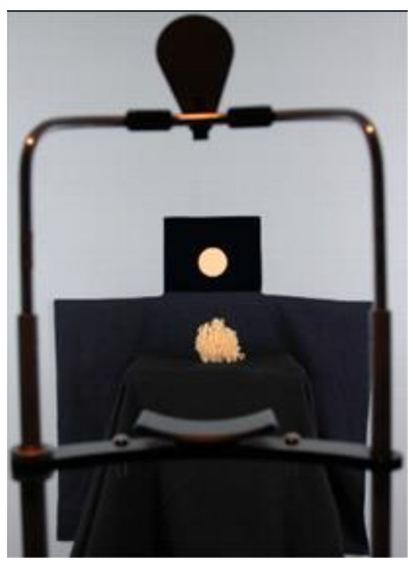
Color 3.0

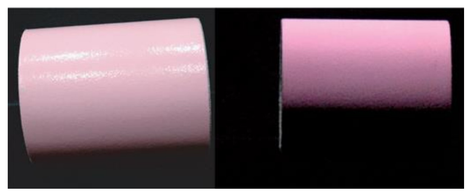
We know a great deal about color constancy and material perception, but we know less about how observers make color matches across materials and even less about how they achieve color constancy across materials. This compounds with the growing prevalence of VR.



Wittgenstein, Remarks on Color
Can a transparent piece of glass have the same colour as an opaque paper?

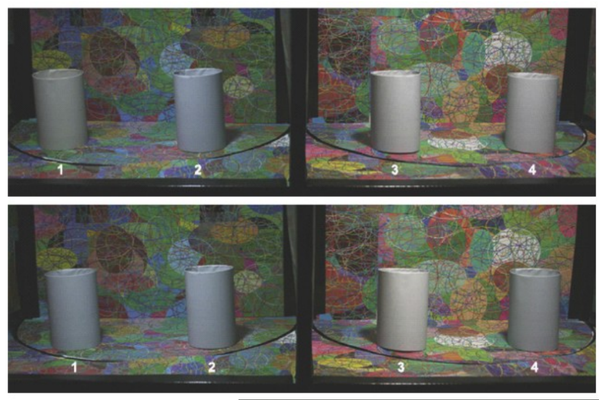


Giesel & Gegenfurtner (2010)
Toscani, Valsecchi & Gegenfurtner (2013)

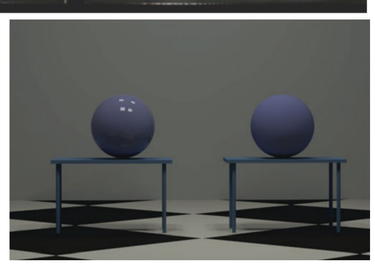


Granzier, Vergne & Gegenfurtner (2014)

Xiao B. (2016) Color Constancy. In: Luo M.R. (eds) Encyclopedia of Color Science and Technology. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-8071-7_266

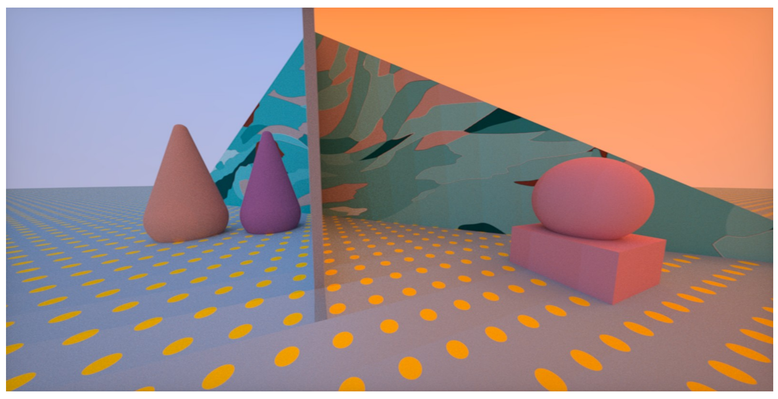


Zaidi & Bostic (2008)

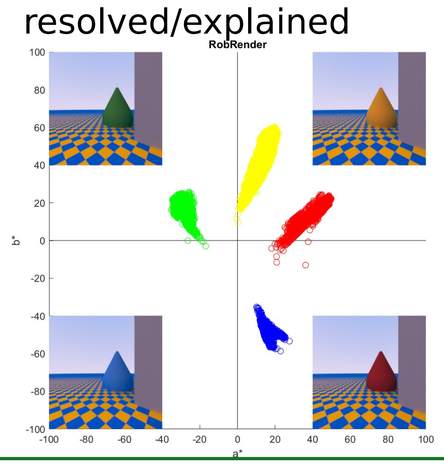


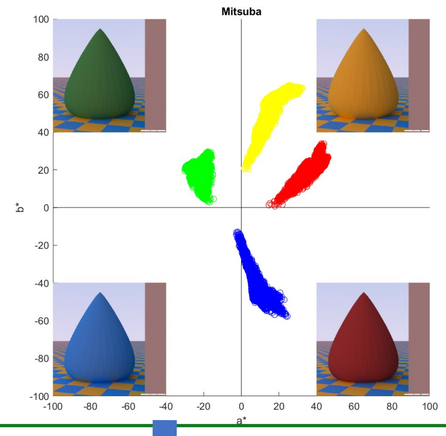
Xiao & Brainard (2008)

We built a GPU-based real-time multispectral pathtracer. It runs in the browser through a WebGL fragment shader. It interfaces with VR headsets through A-frame.

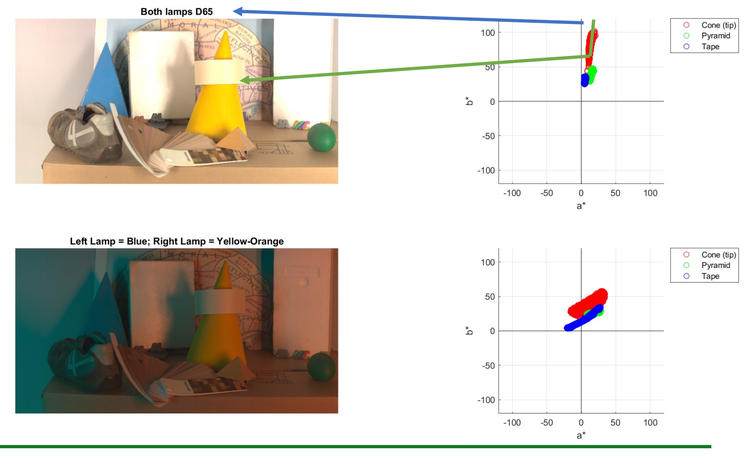


We referenced PBRT, Mitsuba, classic texts, and respected code sources. We validated our renderer against similar Mitsuba scenes. Any differences are negligble for our results and can be easily resolved/explained





In the renders, we found that having two illuminants alters the “Lambertian colors radiate from gray” rule, so we confirmed that this is true in the physical world.

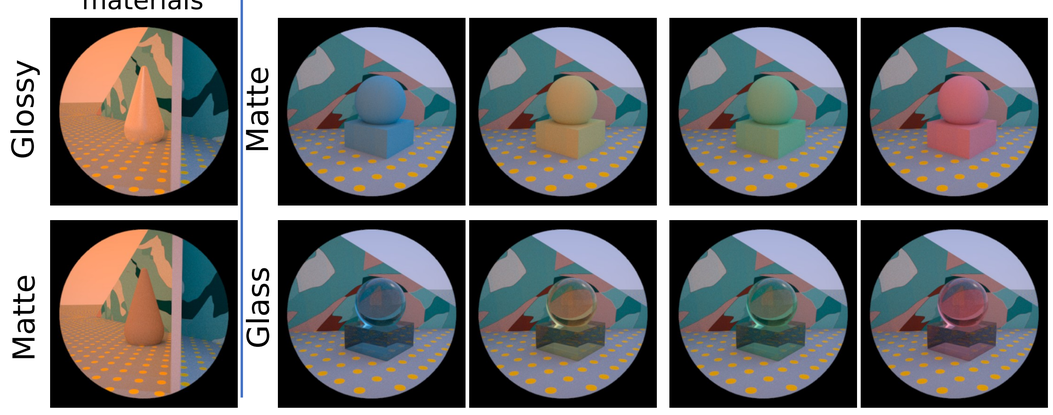


Blur Busters approved

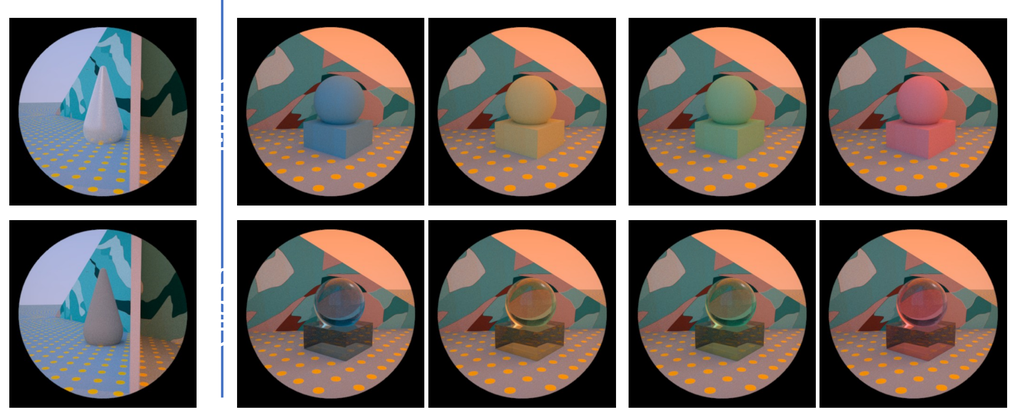
Yellow illuminant left, Blue illuminant right

2 matching materials

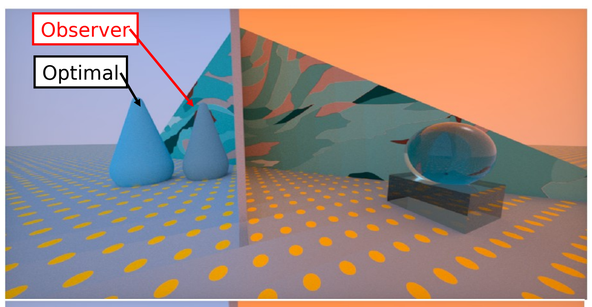
2 test materials, 4 test colors

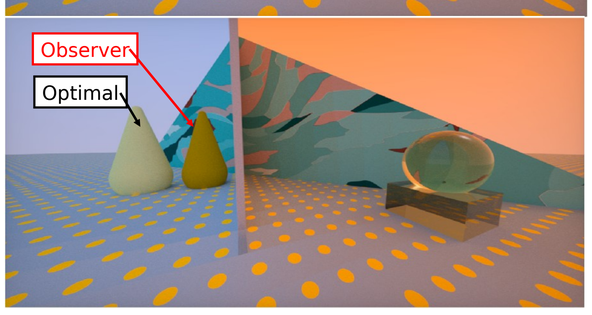


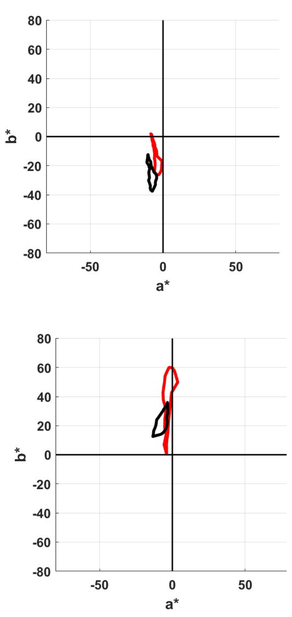
Blue illuminant left, Yellow illuminant right



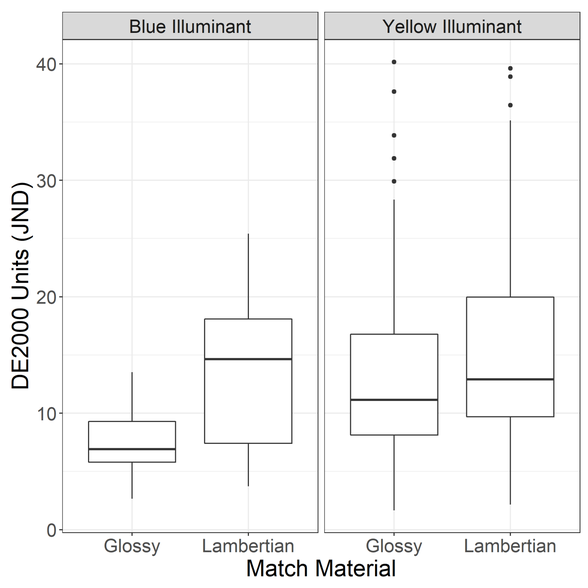
We can estimate observer color constancy by comparing their match to a physical match, where the diffuse reflectance of the physical match is equal to the reflectance/transmittance distribution of the glass object.

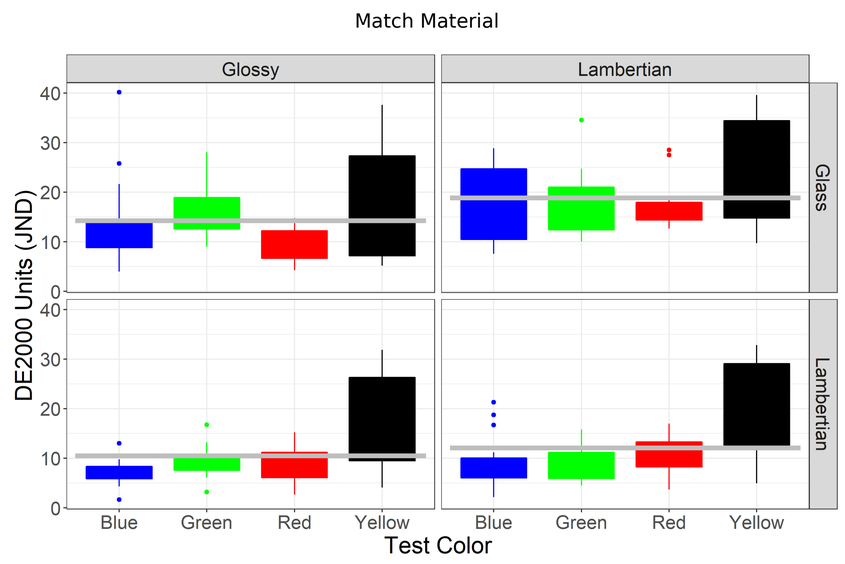






Since we know that the color of Lambertian/glossy objects is determined by the most luminant region (excluding highlights), we can then find the difference between those colors as a proxy for a color constancy index.





Until now, we have found no substantial differences in observer settings between VR and a standard desktop monitor