The effect of CEILING COLOR on interior space perception

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Motivation

Interior-design experts' suggestions

- **Luminance**
  - Perceived height is said to increase both with increasing **ceiling luminance** and increasing **luminance contrast of ceiling and walls** (e.g., Neufert & Kister, 2009)
- **Saturation / Hue**
  - Several specific assumptions like, for example, that **colorful ceiling colors** such as pure red, green, or blue, have an **"oppressive" effect on perceived height** (e.g., Meerwein, Rodeck, & Mahnke, 2007)

Studies on interior space perception

- **Luminance**
  - Perceived height of greyscale three-dimensional room simulations increases with increasing **ceiling luminance** (e.g., von Castell, Hecht, & Oberfeld, 2016)
  - Additive effect of **wall luminance**: maximum perceived height, when both ceiling and walls have maximum luminance (e.g., Oberfeld, Hecht, & Gamer, 2010)

Do luminance, saturation, and/or hue of chromatic ceiling colors influence the perceived height of interior spaces?

Method

Subjects

- *N* = 22 (10 women, 12 men)
- Age 19 to 34 years (M_{age} = 23.95, SD_{age} = 3.57)

Apparatus

Oculus Rift DK2

- FOV: horizontal ≈ vertical ≈ 100°
- Virtual eye height: 1.30 m

Stimuli

3D room simulations

- Independent variation of ceiling luminance, saturation, and hue
- Constant luminance of rear and side walls (M_Y = 25.46 cd m^{-2})
- Variation of ceiling height
- Constant room width (4.50 m) and depth (5.80 m)

*Measured with a **spectroradiometer***

*Colorimetric values calculated from **CIE L*a*b* color space, D65 white point, 10° standard observer***

Design and Procedure

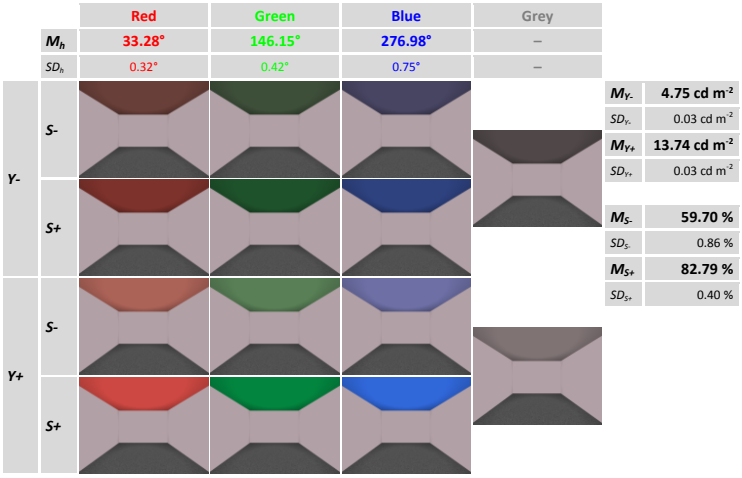
Independent variables (IVs)

- Luminance *Y* (*Y-*, *Y+*)
- Saturation *S* (*S-*, *S+*)
- Hue *h* (Red, Green, Blue)
- Luminance-matched achromatic ceilings (Grey)
- Ceiling height (2.90, 3.00, 3.10 m)

Dependent variable (DV)

- Centimeter ratings of **perceived height**

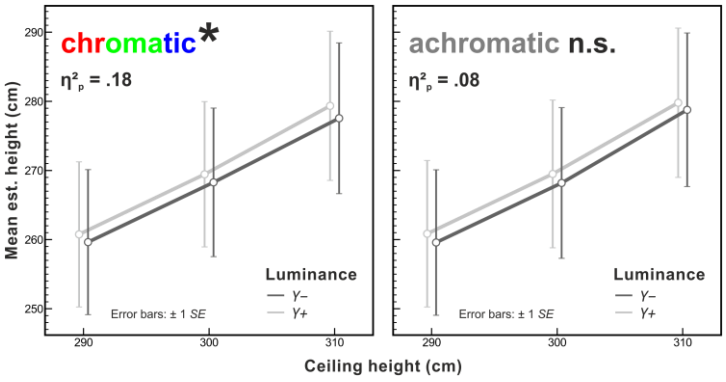
⇒ *[**2**(Y) × **2**(S) × 3(h) + **2**(Y achromatic)] × **3**(Ceiling height) × **10**(trials per combination of IVs) = **420 trials** per subject*



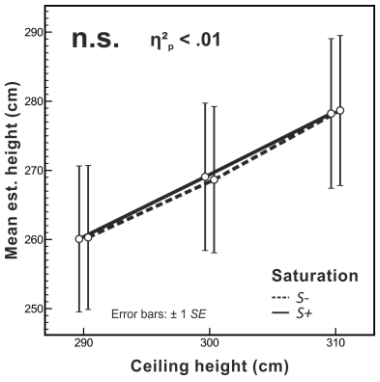
Results

***Y* × *S* × *h* × Ceiling height rmANOVA for *chromatic* ceiling colors**
***Y* × Ceiling height rmANOVA for *achromatic* ceiling colors**

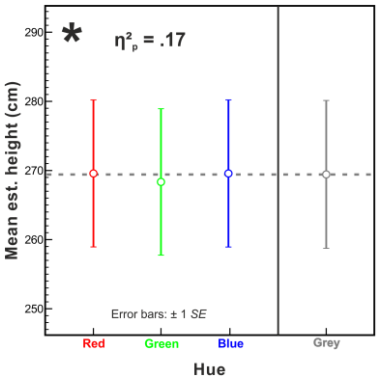
Luminance



Saturation



Hue



Ceiling height*

- Perceived height increased with increasing ceiling height, both for chromatic (η^2_p = .81) and achromatic (η^2_p = .76) ceiling colors

Luminance × Hue × Ceiling height* (η^2_p = .13)

- Maximum effect of hue on perceived height for medium-high (3.00 m) high-luminance (*Y+*) ceilings (not illustrated)

Note: All other effects n.s.

Conclusion

- The previously reported achromatic luminance effect can be generalized to chromatic ceiling colors: subjects judged lighter ceilings higher than darker ceilings, independent of saturation and hue
- Absence of luminance effect in the achromatic condition probably due to a smaller luminance difference than in previous studies (e.g., Δ_Y = 16.46 cd m^{-2} in von Castell et al., 2016)
- First indications that ceiling hue influences the perceived height of interior spaces: subjects judged green ceilings slightly lower than red, blue, and grey ceilings
- Virtually no effect of saturation
- No evidence for an "oppressive" effect of colorful ceilings on perceived height

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References

Meerwein, G., Rodeck, B., & Mahnke, F. H. (2007). *Farbe –Kommunikation im Raum* (4th ed.). Basel: Birkhäuser.

Neufert, E., & Kister, J. (2009). *Bauentwurfslehre* (39th ed.). Wiesbaden: Vieweg & Teubner.

Oberfeld, D., Hecht, H., & Gamer, M. (2010). Surface lightness influences perceived room height. *Quarterly Journal of Experimental Psychology, 63*, 1999-2011.

von Castell, C., Hecht, H., & Oberfeld, D. (2016). Measuring perceived ceiling height in a visual comparison task. *Quarterly Journal of Experimental Psychology, 1-17.*

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