The impact of 'crispening' upon the perceived contrast of textures.

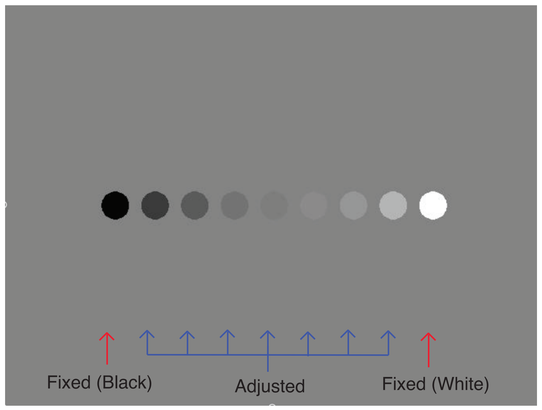
Universitat Pompeu Fabra Barcelona

David Kane & Marcelo Bertalmío

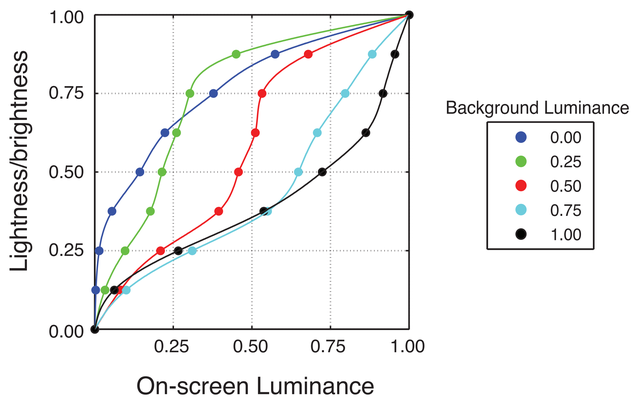
david.kane@upf.edu

Lightness/brightness experiment

- We investigate the impact of lightness/brightness perception upon the perceived contrast of textures.
- Experiment One. Task: Adjust the luminance of the below test patches until they appear to linearly transition between black to white.
- Five background luminance conditions, from black to white.

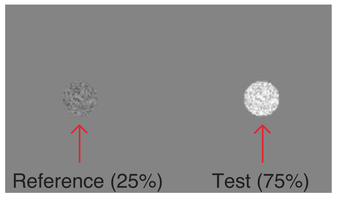


Results



- The estimated luminance to lightness functions are similar to Whittle (1986).
- Whittle felt the non-linearity was composed of a global non-linearity and a local 'crispening effect'.
- 'Crispening' is an increase in sensitivity around the background luminance and a bias in perception away from the background luminance.

Contrast experiment



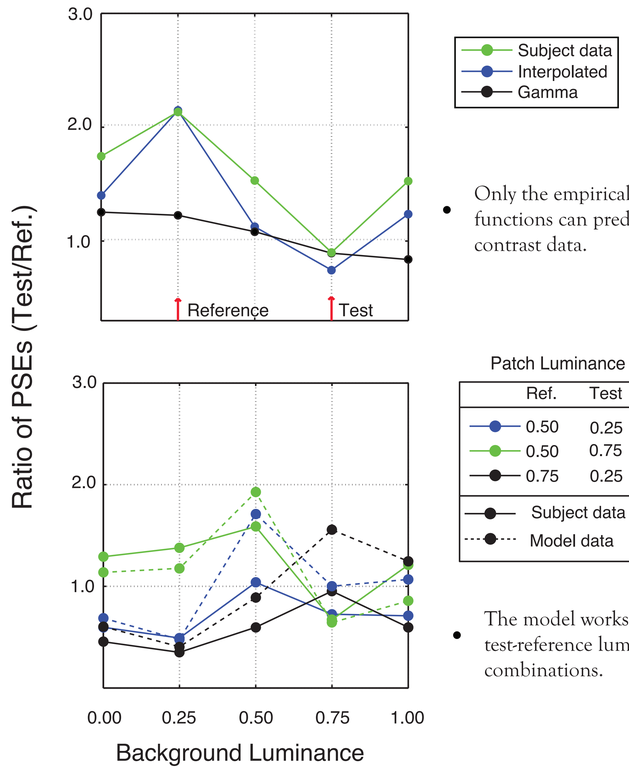
- Experiment Two. Task: Indicate which of two patches has greater contrast.
- Estimate the point of subjective equality (PSE).
- Five background conditions.

Results and Model

- We model lightness either using a power law or the empirically estimated functions (opposite).
- Contrast is computed as the standard deviation of the 'lightness' image, followed by a power-law non-linearity (Kane & Bertalmío, submitted).

$$[1] \quad L_i = f(I_i)$$

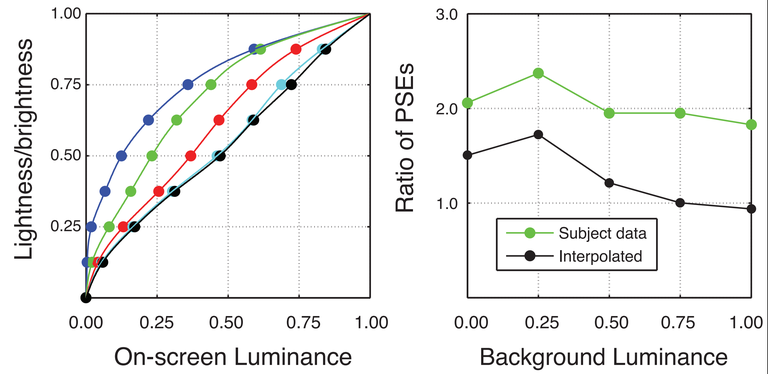
$$[2] \quad C = \sigma(L_i)^{0.35}$$



- Only the empirical lightness functions can predict the contrast data.
- The model works for other test-reference luminance combinations.

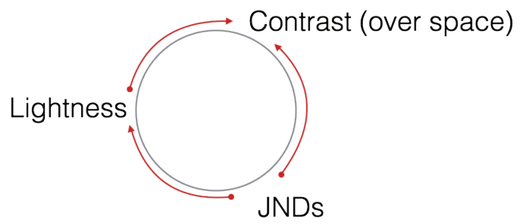
More results

- Whittle (1986) noted that the effect of crispening disappeared when a small surround was added to the stimulus.



- Adding a thin outline (not-equiluminant) dramatically affects the shape of the lightness/brightness functions, reducing the crispening effect.
- The contrast functions are also affected. Although our model cannot predict the contrast data yet (the lightness-brightness functions must expand the dark luminance values more).

Discussion



Previous work has established a correlation between sensitivity to luminance variations (i.e. JNDs) and the super-threshold perception of lightness/brightness (Fechner, 1860). In this work we establish a relationship between lightness/brightness and the perception of contrast over space.

Many contemporary models of contrast perception apply a non-adaptive luminance non-linearity (typically a simple power law or a logarithmic transformation).

Given that lightness perception is highly sensitive to the exact experiment conditions (ambient lighting, display device) and research using laboratory stimuli, does not generalize well to natural scenes (Bartleson, 1975), we argue that without a general model of lightness/brightness perception, a general model of contrast perception is also out of reach.

Whittle (1986). Brightness, Discriminability and the"Crispening Effect". Vision Research
Bartelson (1975). Optimum Image Tone Reproduction. Journal of the SMPTE
Kane & Bertalmío (Submitted). The role of lightness perception in determining the perceived contrast of natural scenes.