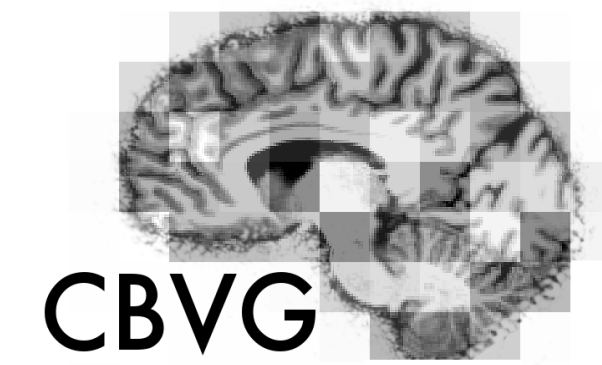


Effect of relative total area on perceived lightness



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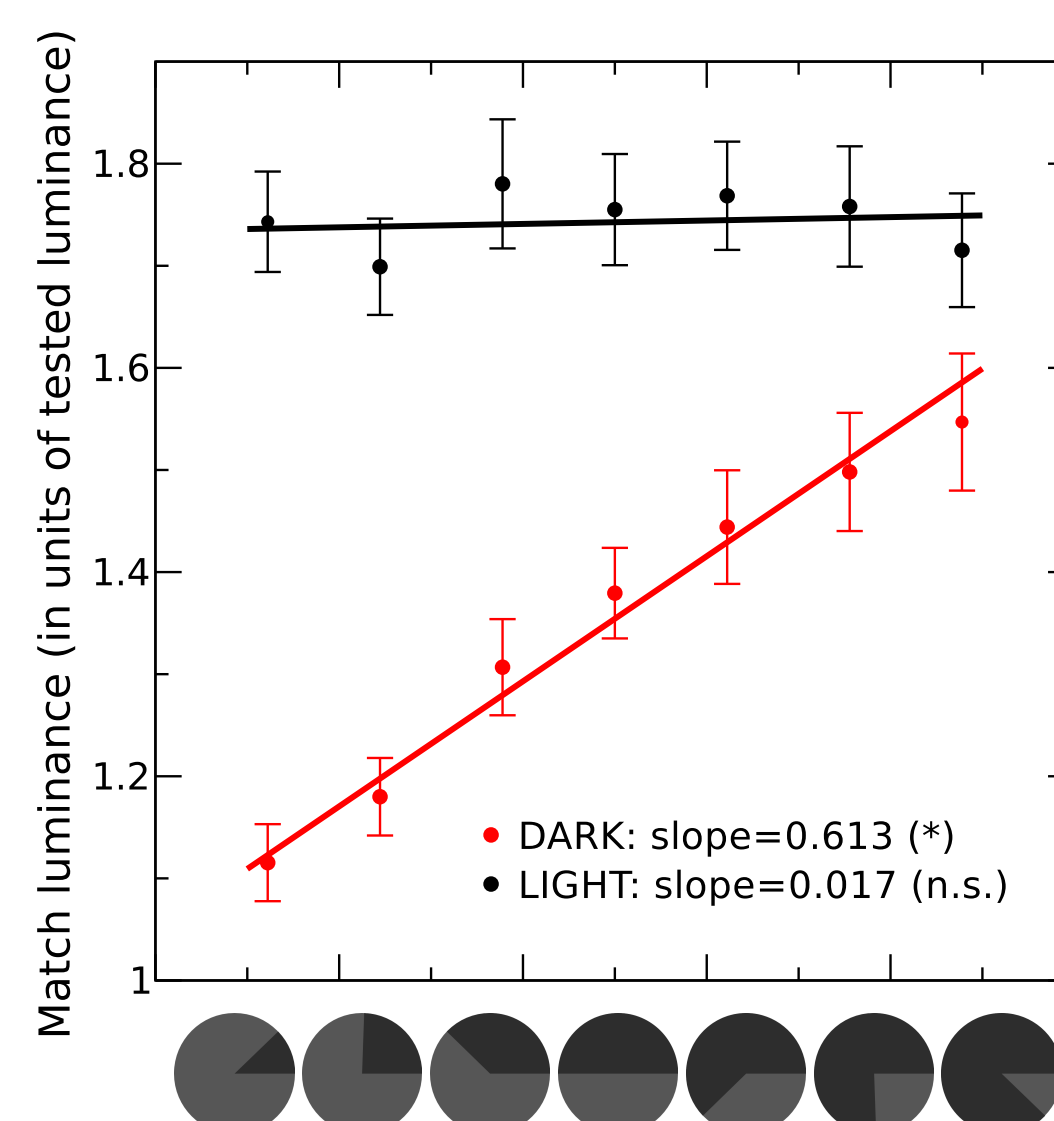
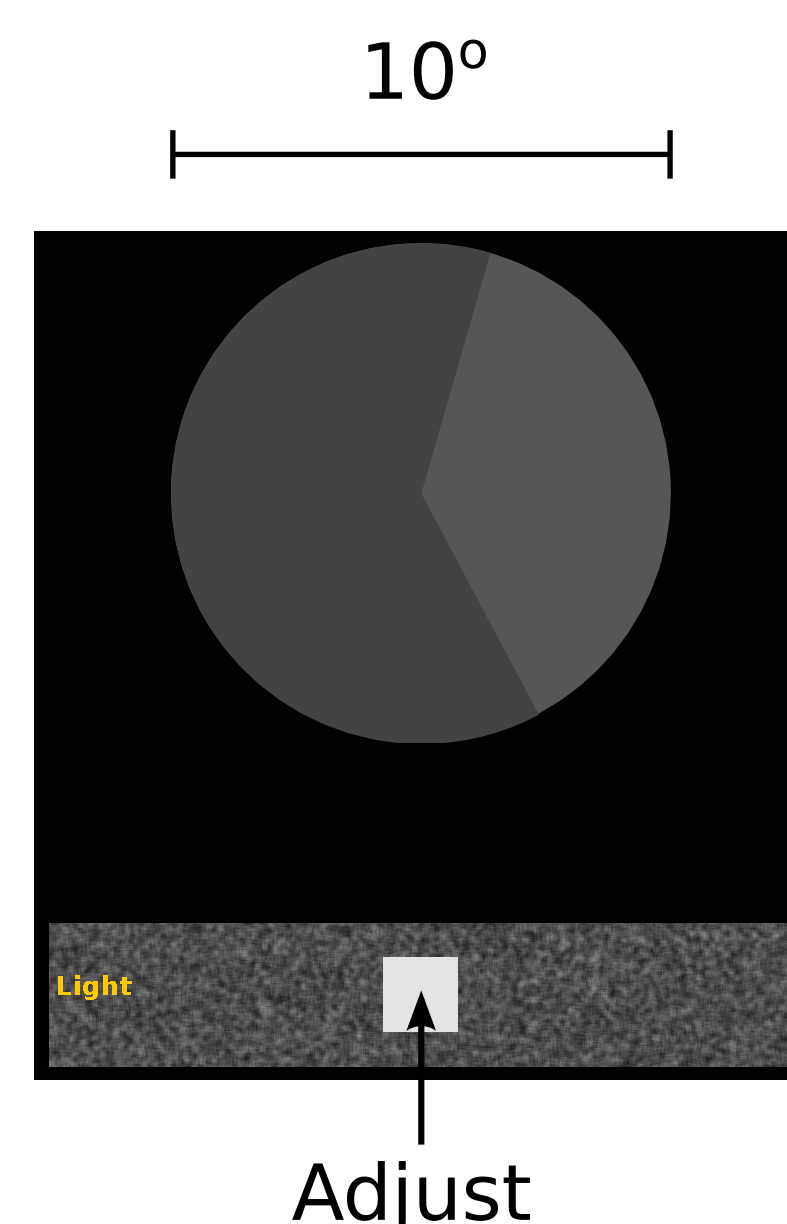
<http://vision.bilkent.edu.tr>

Introduction

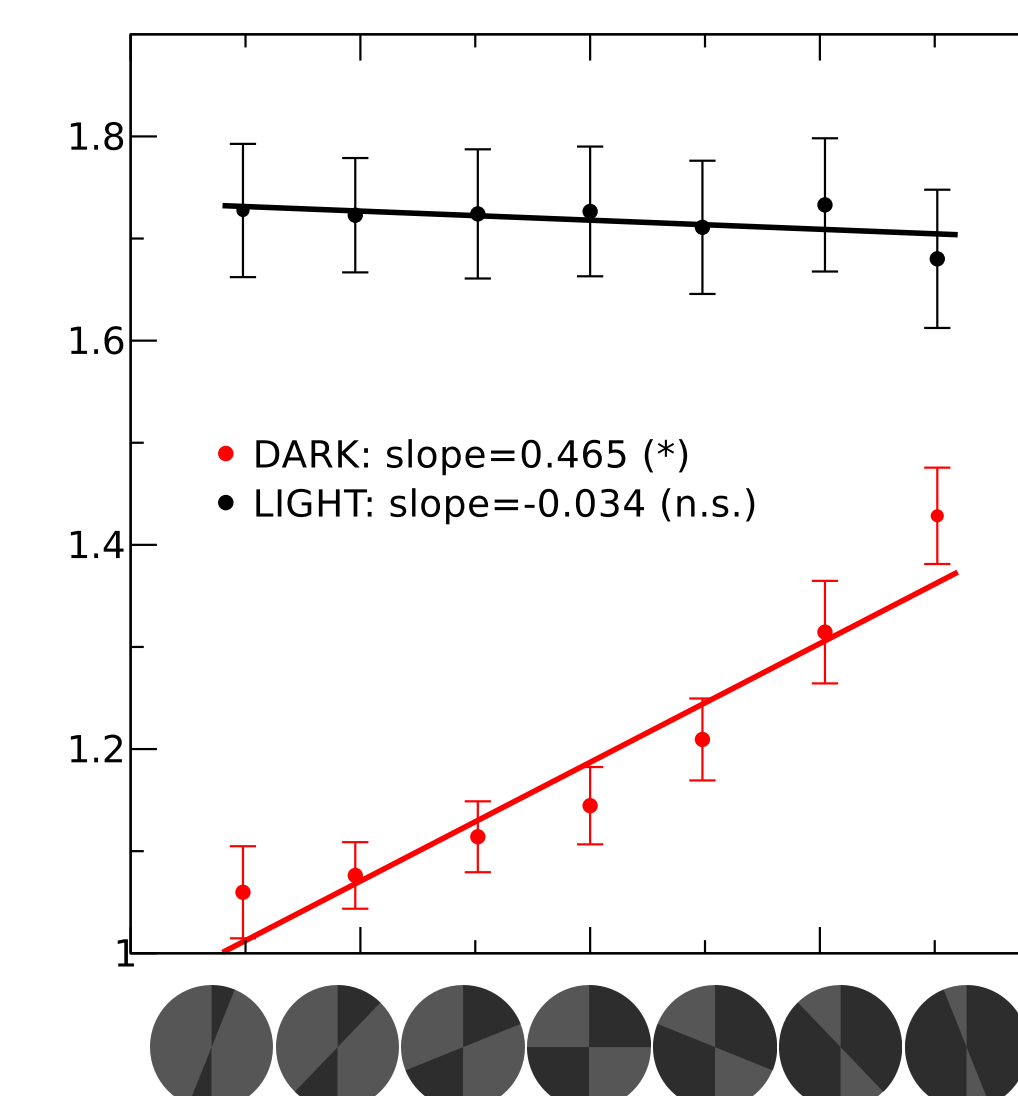
In a simple two dimensional (2D) display composed of two uniform contiguous surfaces of different luminances, perceived lightness of the surfaces varies as a function of their relative areas while their luminance remains unchanged. Despite empirical evidence dating back to the first half of the 20th century, there is still no clear explanation for this "area rule" of lightness [1]. Here we sought to differentiate contributions of low level mechanisms, e.g. pooling of neuronal responses in early visual areas [2], and higher level processes, e.g. perceptual grouping to the effect. For this purpose we conducted two series of experiments. First we investigated the effect using non-contiguous surfaces. We hypothesized that the effect should reduce if low level mechanisms are responsible. In the second series of experiments we manipulated the perceived z-order of surfaces, i.e. back/front. We expected to see significant differences between back and front conditions if higher level mechanisms play a crucial role. Our results suggest that both low level and high level mechanisms have roles on this classic lightness effect.

Experiment 1: N_SECTOR=2

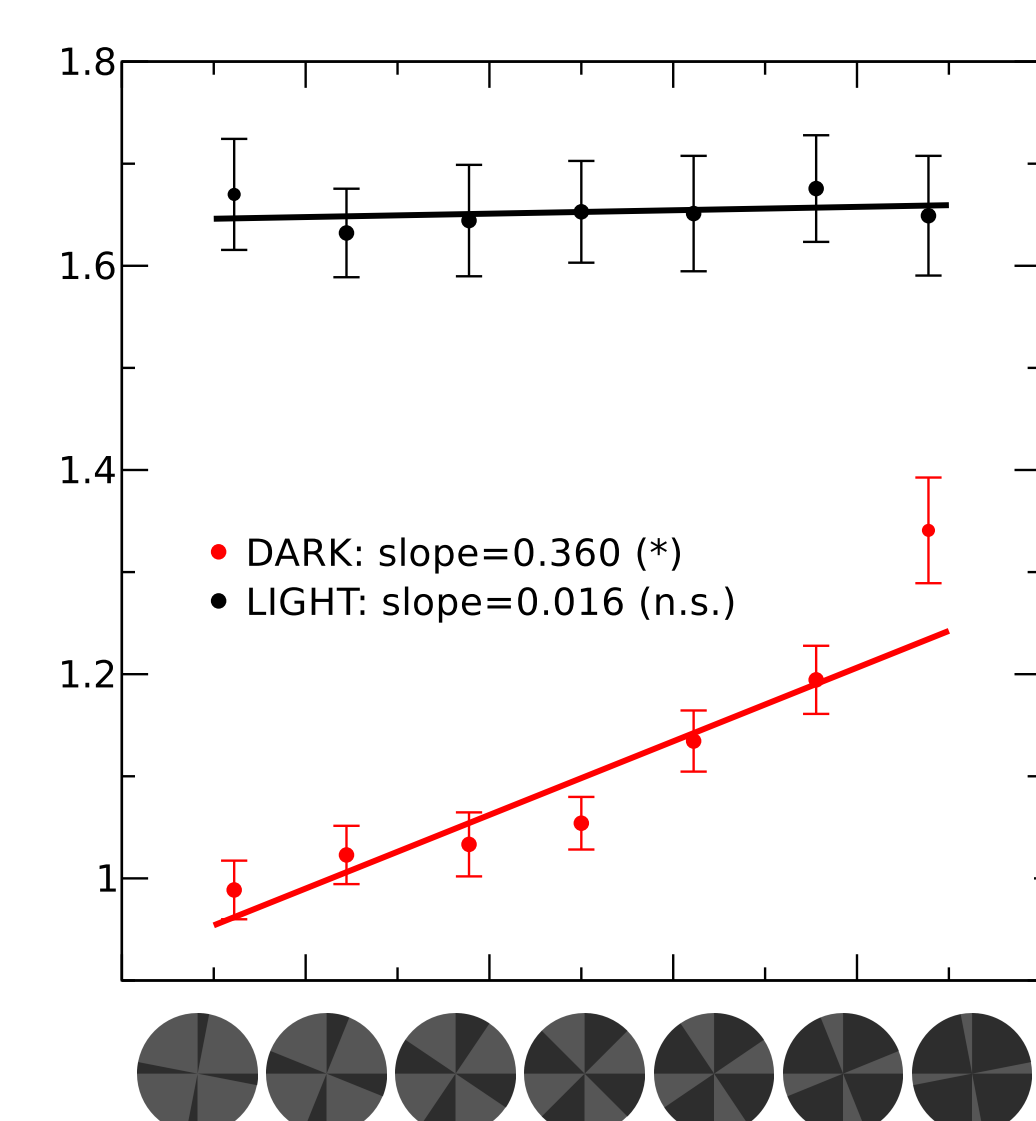
Methods. 7 naive participants; 10 repetition at each condition; Participants seated 60 cm away from an LCD screen (NEC 21" 2190UXP); Light sector luminance = 25 cd/m²; Dark sector luminance = 8 cd/m².



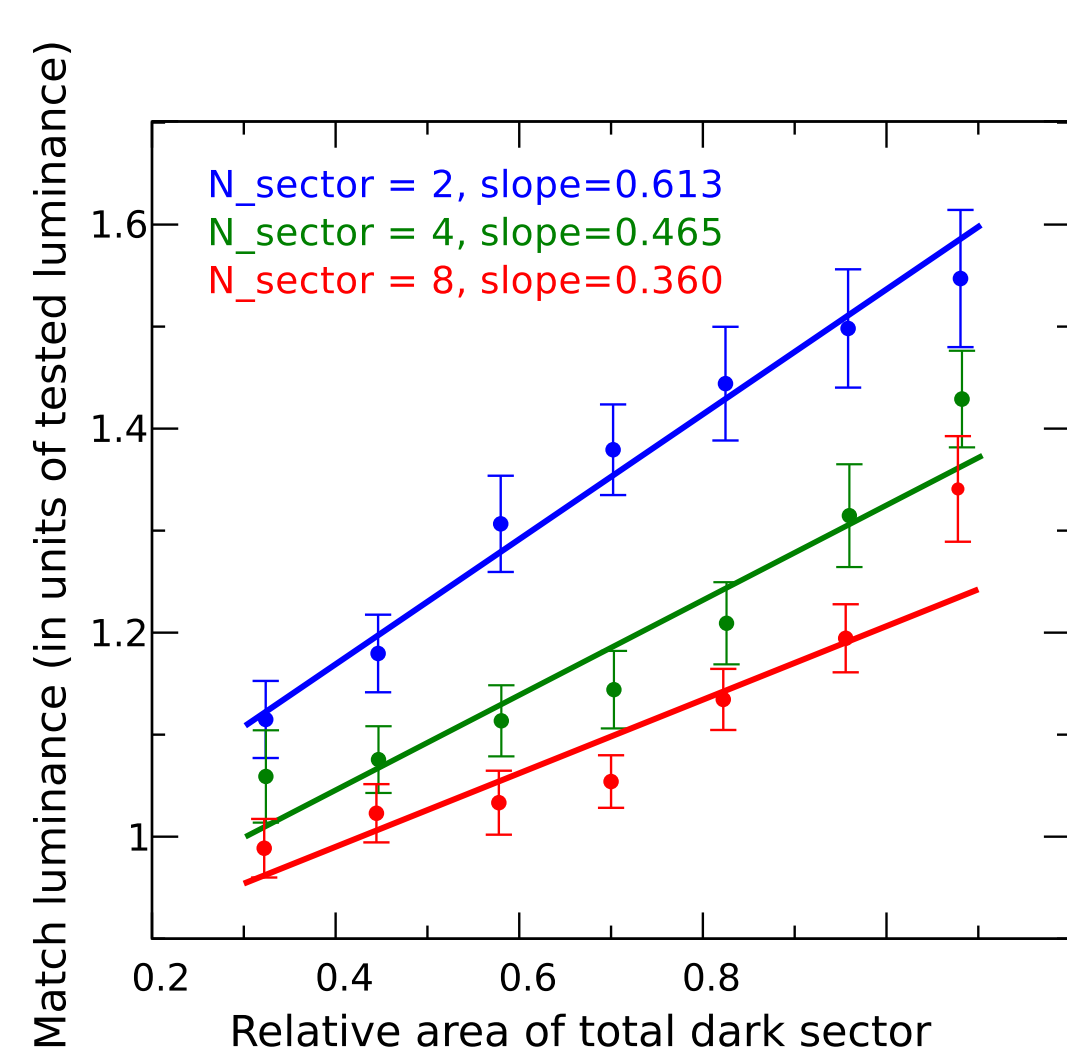
Experiment 2: N_SECTOR=4



Experiment 3: N_SECTOR=8

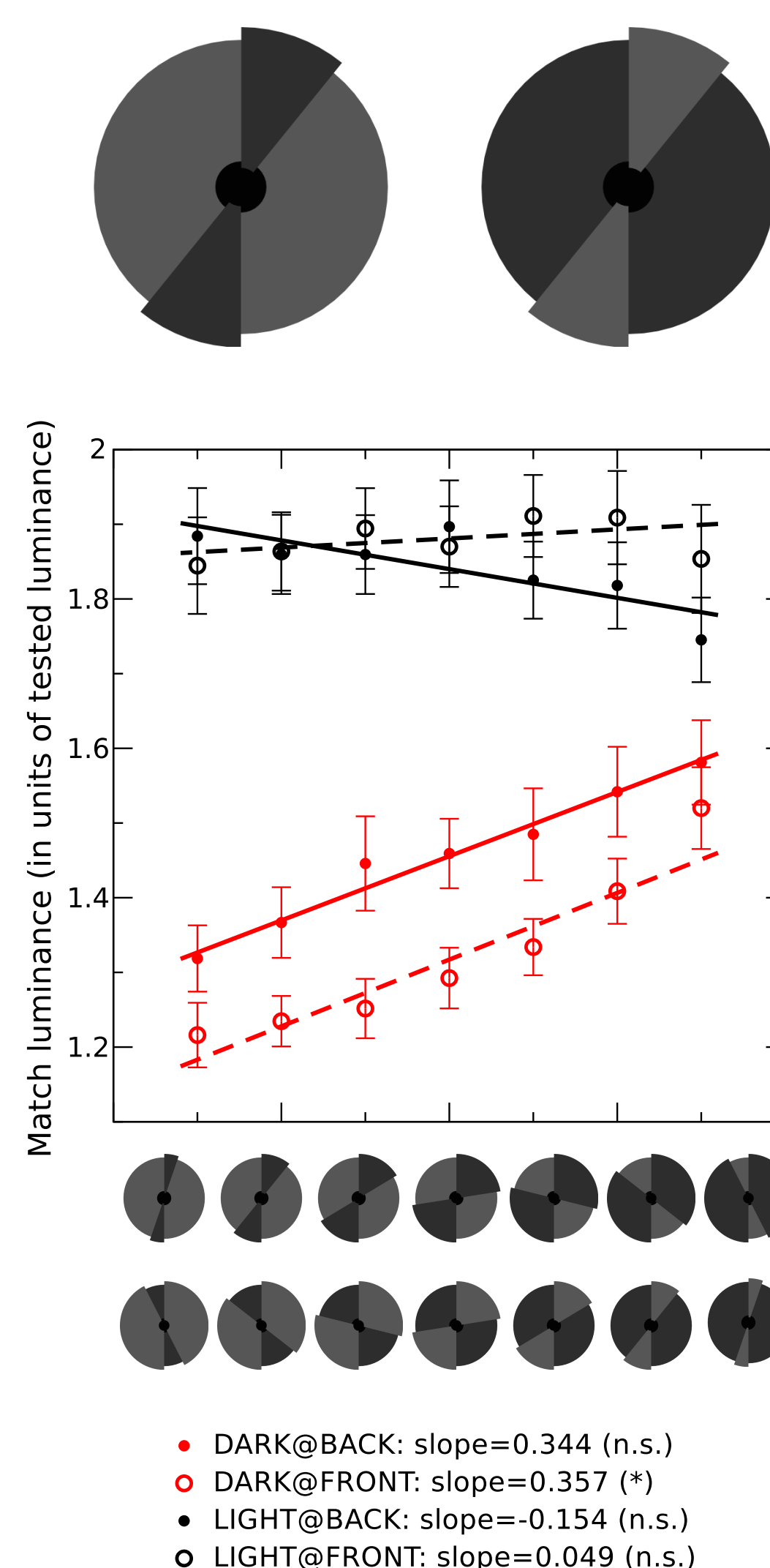


N_SECTOR=2 vs 4 vs 8 (dark sectors)

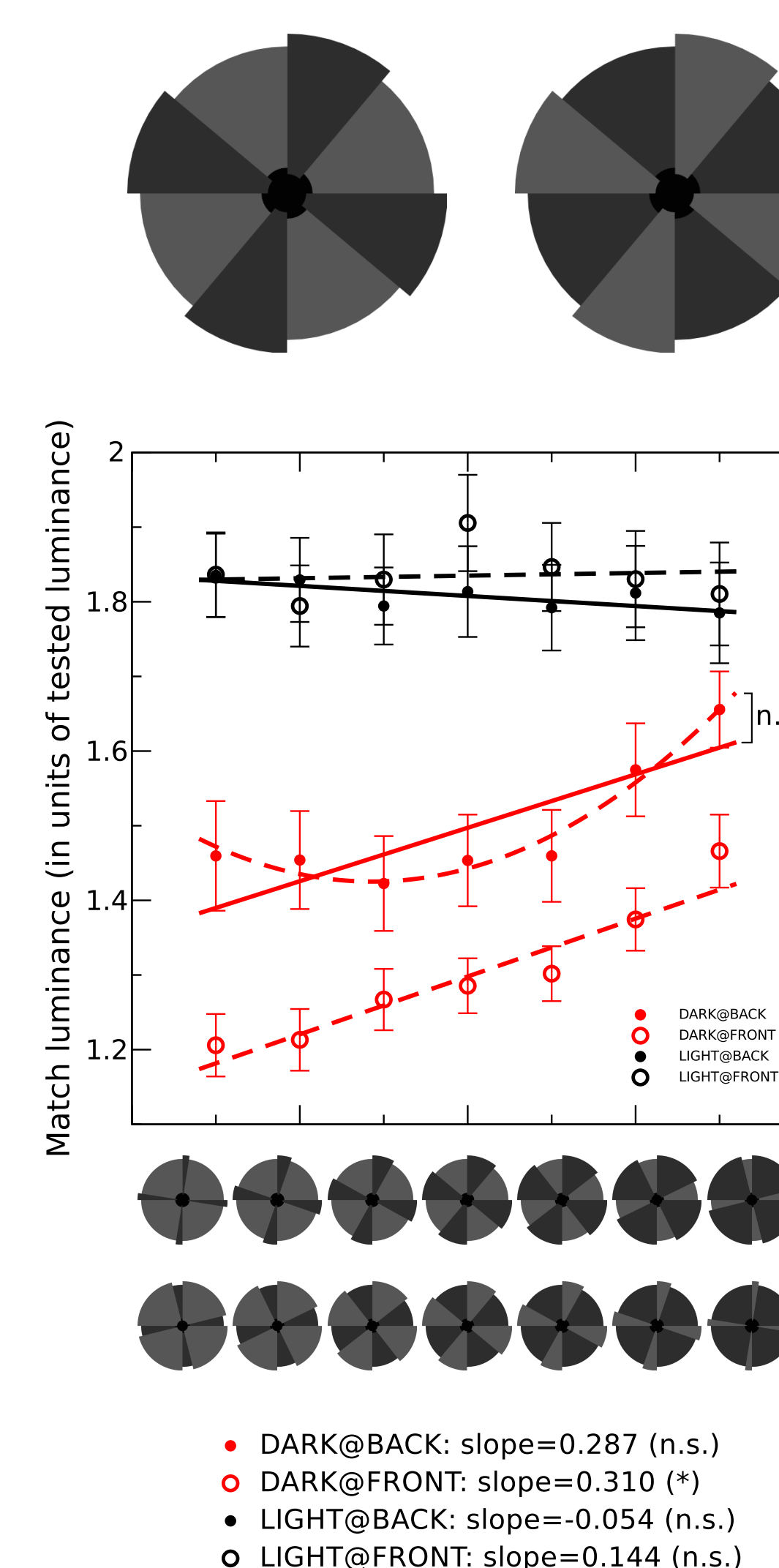


- Are N_S=2 and N_S=4 slopes different? No (n.s.)
- Are N_S=2 and N_S=8 slopes different? Yes (*)
- Are N_S=4 and N_S=8 slopes different? Yes (*)
- Are N_S=4 slope and half of N_S=2 slope different? No (n.s.)
- Are N_S=8 slope and quarter of N_S=2 slope different? Yes (*)
- Are N_S=8 slope and half of N_S=4 slope different? Yes (*)

Experiment 4: N_SECTOR=4 @Back/Front



Experiment 5: N_SECTOR=8 @Back/Front



Discussions

In Experiment 1-3, consistent with literature [1], we found that perceived lightness of the dark sectors, but not the light sectors, increase with their area

Differences in slopes in Experiment 1-3 suggest that both high level and low level mechanisms might be causing the effect

Experiment 4 & 5 results show that the dark surface is perceived lighter when it is in the background. This is consistent with the Wolff illusion

Results of Experiment 4 & 5 suggest that area rule applies only when the dark surface is perceived in the foreground

References

1. Gilchrist and Radonjic, Anchoring of lightness values by relative luminance and relative area, Journal of Vision, 2009
2. Richards, W., Apparent modifiability of receptive fields during accommodation and convergence and a model for size constancy, Neuropsychologia, 1967.

Acknowledgements

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