Surround modulation of perceived contrast and the role of brightness induction

Cong Yu School of Optometry, University of California, Berkeley, CA, USA

Stanley A. Klein School of Optometry, University of California, Berkeley, CA, USA

Dennis M. Levi College of Optometry, University of Houston, Houston, TX, USA

We studied iso- and cross-orientation surround modulation of perceived contrast (contrast-contrast phenomenon) with a contrast-matching method. Our results indicate (1) iso-oriented surrounds at all contrasts suppress perceived contrast of the test pattern. Cross-orientation surrounds, however, tend to enhance the perceived contrast of the test, particularly for high-contrast test patterns. Iso-orientation modulation acts over larger distances than does cross-orientation modulation. Surround modulation of perceived contrast is not accompanied by a simultaneous change of discrimination threshold. (2) Iso-orientation surround suppression is phase insensitive when brightness induction due to local luminance contrast is eliminated by a small center-surround gap. (3) Perceived contrast is similarly affected when the surround spatial frequency is equal to or higher than the center spatial frequency, but lower spatial frequency surrounds markedly enhance perceived contrast as a result of brightness induction. These data indicate that the contrast-contrast phenomenon is often mixed with brightness induction when it is measured with sinusoidal grating stimuli, and we suggest that this may account for some of the individual differences. After excluding the role of brightness induction, surround modulation of perceived contrast appears to be a second-order process that is phase independent and not tuned or very broadly tuned to spatial frequency.

Keywords: contrast matching, contrast discrimination, surround modulation, brightness induction, second-order processing

Introduction

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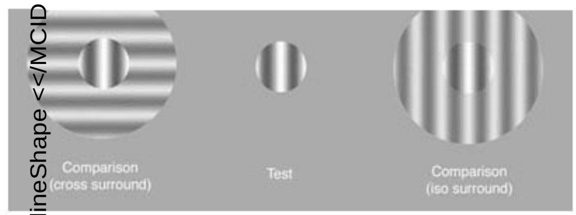
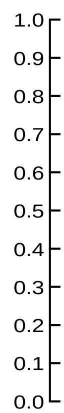


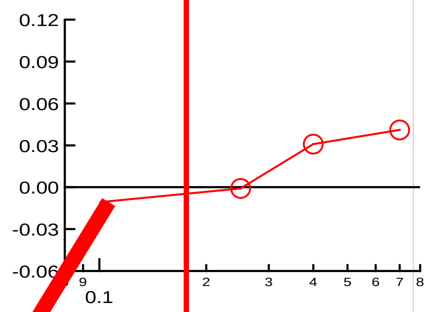


Methods

Results

Iso-orientation.

Cross-orientation.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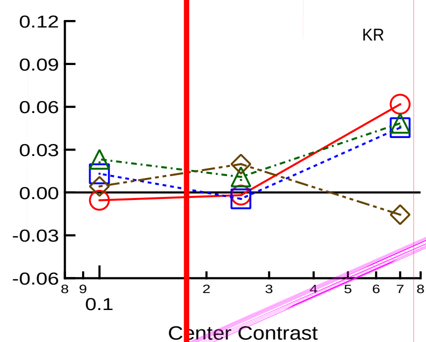
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Center Contrast

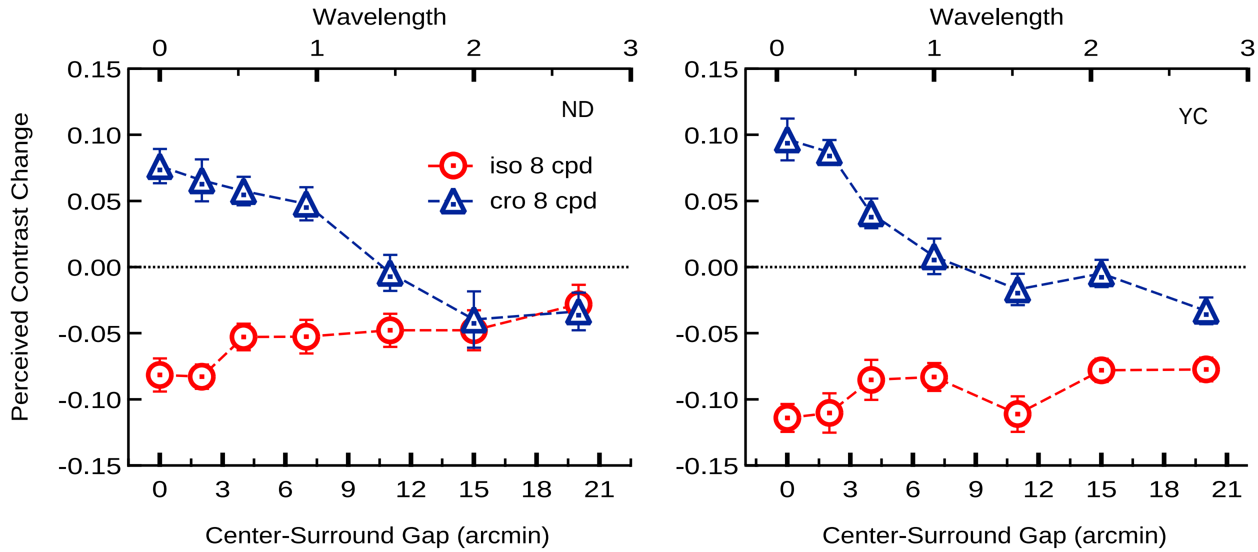


Figure 4. Contrast change as a function of center-surround gap size. The area of the surround is constant across gap sizes.

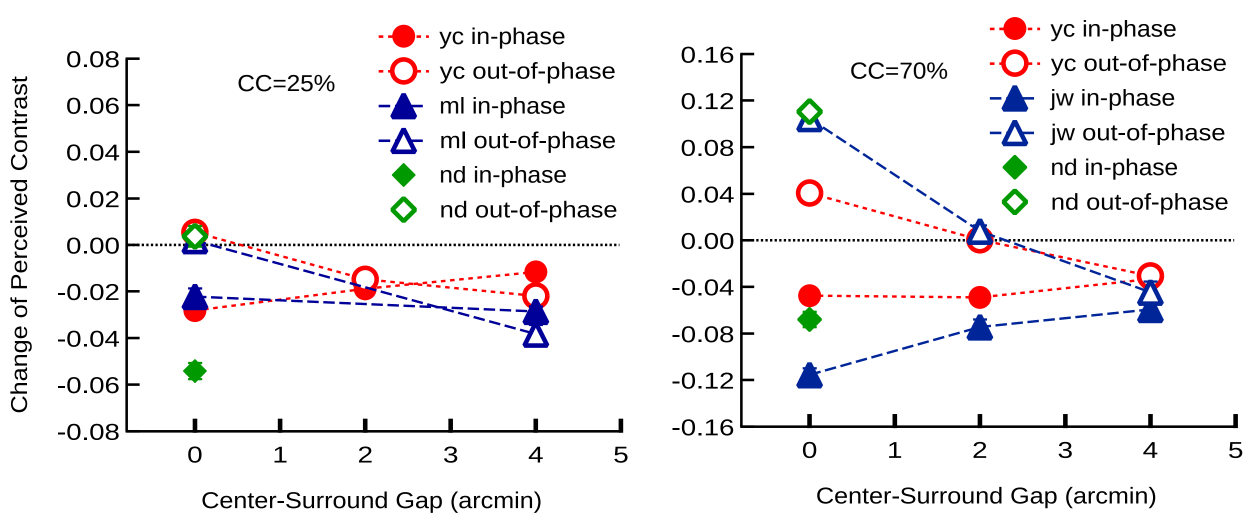
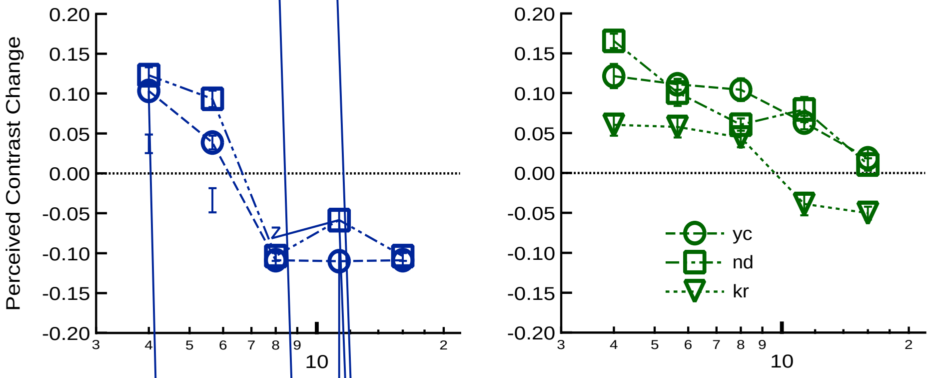


Figure 5. Perceived contrast change as a function of center-surround gap under in-phase and out-of-phase conditions. The surround contrast is 0.40. CC indicates center contrast.


Perceived Contrast Change
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0.00
-0.05
-0.10
-0.15
-0.20
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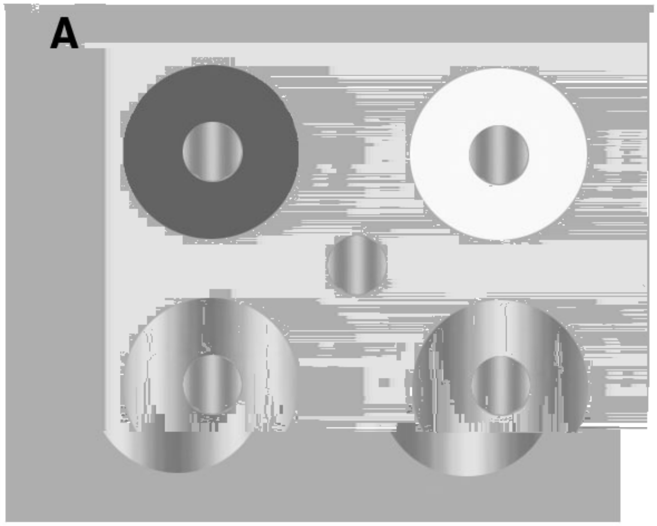

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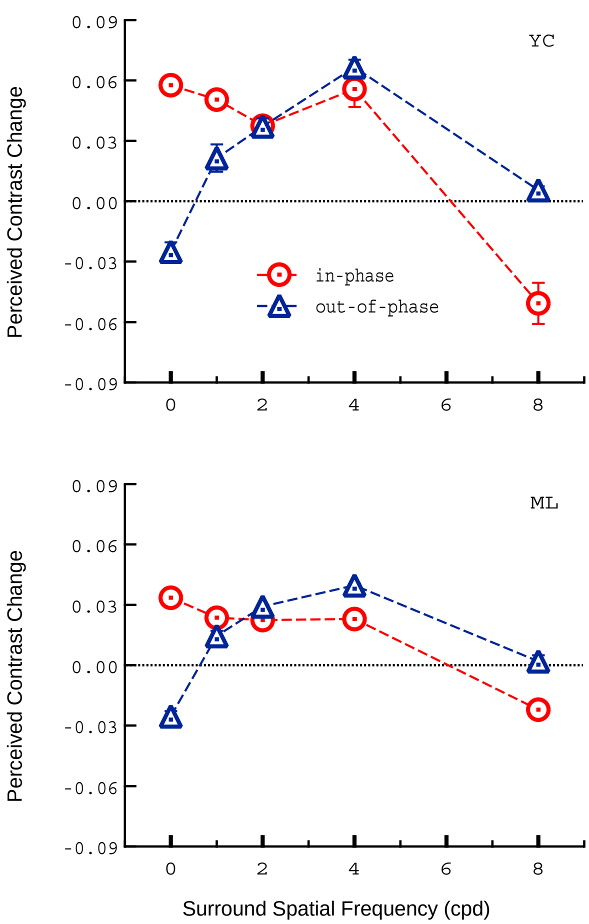

Figure 8. A. Samples of stimuli. B. Perceived contrast change as a function of surround spatial frequency under in-phase and out-of-phase conditions. Center contrast = 0.25; surround contrast = 0.40.

Discussion

Conclusions

Acknowledgments

References

Vision Research

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Computer Vision and Image Processing

Journal of Physiology

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