

# Psychophysical evidence for competition between real and illusory contour processing

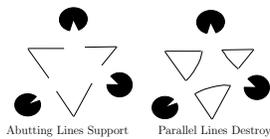
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## 1 Introduction

Luminance defined and illusory contours provide vital information about object borders. However, real and illusory contour cues tend to be used under different contexts and can interfere with one another.

Do real lines help or hurt?  
Does orientation matter?



Although some cells in visual cortex process both real and illusory contours equivalently, recent studies[5, 3] suggest competitive interactions between real (feedforward) and illusory (feedback) contour processing in primate V1 and V2. We tested this psychophysically by presenting illusory contours with and without the presence of real line components.

## 2 Methods

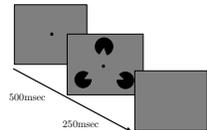
### Stimulus

We used a Kanizsa-type stimulus in a shape discrimination task similar to the one used by Ringach et al.[4]. Orthogonal or parallel real lines were superimposed onto one side of the illusory figure.

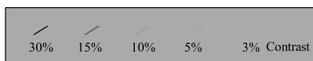


### Experiment

Discrimination thresholds for the outward vs. inward bent virtual contour were measured in a 2AFC task.



Real lines were varied in contrasts. Detection thresholds for real lines were measured separately for each subject.



### Subjects

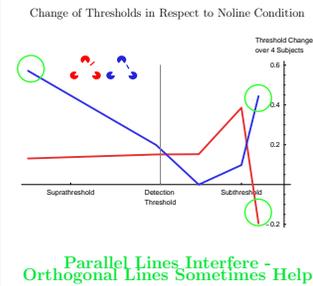
Four subjects between 20 and 27 years participated in this experiment. All of them had either normal or corrected to normal vision. Three of the subjects were naive as to the purpose of the experiments.

## 3 Contrast & Orientation Dependency

The strength and sign of influences of the real lines was measured at different supra- and subthreshold contrasts.

### Average of aligned data

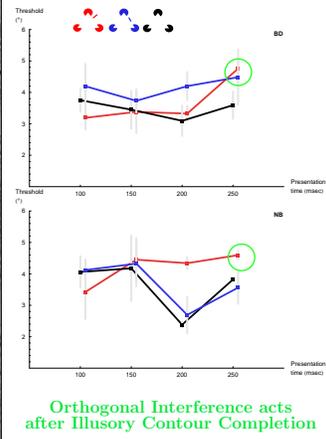
Discrimination thresholds of 4 subjects were aligned to detection threshold for real lines and averaged.



## 4 Time Dependency

ICs are completed after 200-300 msec[4, 1] When in IC processing do real lines interfere?

We tested the timing of the observed interferences with different presentation times with real lines of one subthreshold contrast.

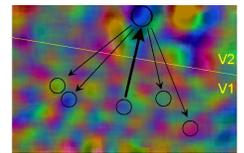


## 6 Summary

- Superimposed real lines degraded the percept of the illusory contour
- Such interference occurred even at subthreshold real line contrasts
- In some subjects interferences were greater for the parallel real line
- Real line interferences varied over contrasts, but also over time
- Interferences for orthogonal lines developed at about 200 to 250 msec

## 7 Conclusions

Our results support the presence of separate mechanisms for the processing of real and illusory contours and suggest that, under some circumstances, real cues can interfere with the processing of illusory cues. We suggest that such interferences occur by the feedforward influences of the lines which interfere with the proposed feedback influences prominent during illusory contour processing.

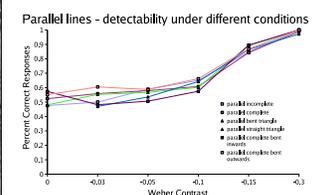


## 8 Outlook

- Is there physiological evidence for orientation dependent interactions between real and illusory contour processing?
- What is the timeframe in which interactions at different contrasts occur?
- Are different types of virtual contours similarly affected by real line interferences?
- Are these interactions relevant in nature?

## 5 Detectability of Real Lines

Different studies [7, 2] tested the perceptual strength of illusory contours by means of detectability measurements of superimposed real contours. Do we find the same effects as for the illusory contour percept also for the real line detectability?



We measured detection thresholds for real lines under different conditions and found them to be inconsistent with the effect of real lines onto the perceptual strength of the illusory contour.

## References

- [1] T.S. Lee and M. Nguyen. Dynamics of subjective contour formation in the early visual cortex. *PNAS*, 98:1907-11, 2001.
- [2] M.E. McCourt and K. Paulson. The influence of illusory contours on the detection of luminance increments and decrements. *Vis. Res.*, 34(18):2469-75, 1994.
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- [4] D.L. Ringach and R. Shapley. Spatial and temporal properties of illusory contours and amodal boundary completion. *Vision Res.*, 36(19), 1996.
- [5] A.W. Roe. in: *The Primate Visual System*. CRC Press LLC, 2003.