2018-02-12 Perceptual organization

PSY 525.001 • Vision Science • 2018 Spring

Rick Gilmore

2018-02-12 12:05:51

Today's topics

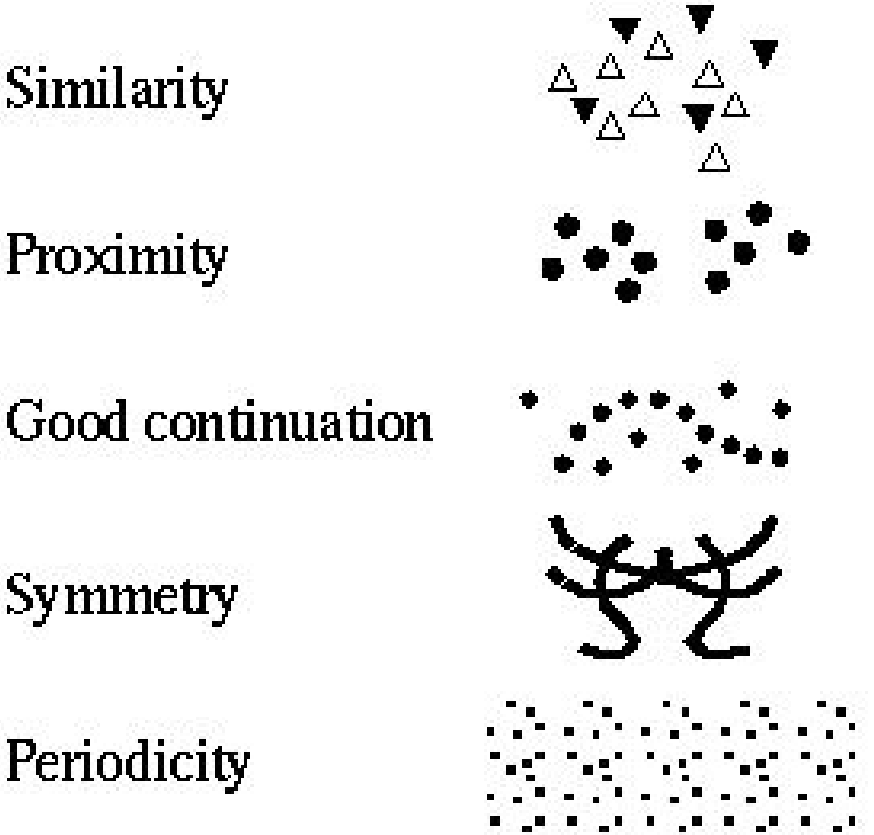
Today's topics

Perceptual organization

Today's topics

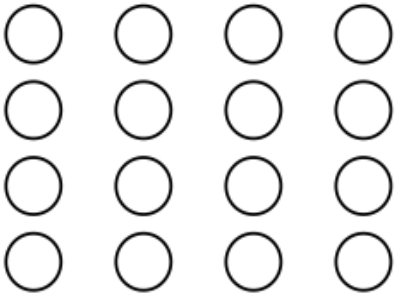
Perceptual organization

Discuss Biederman (1987).

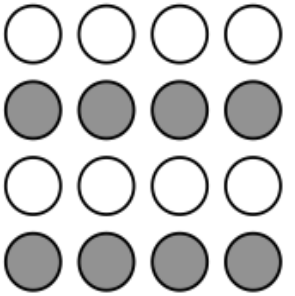


Perceptual grouping

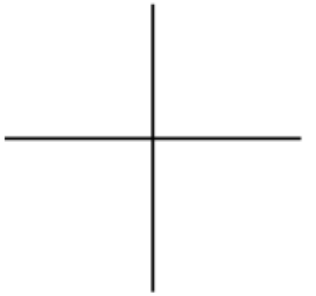
proximity



similarity

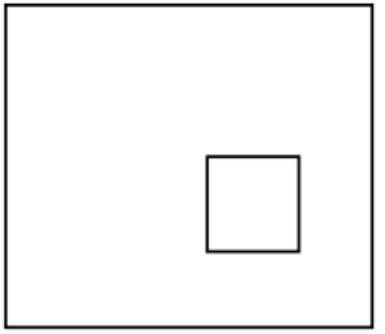


continuity

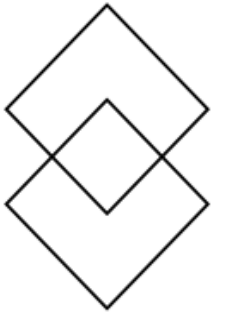


closure

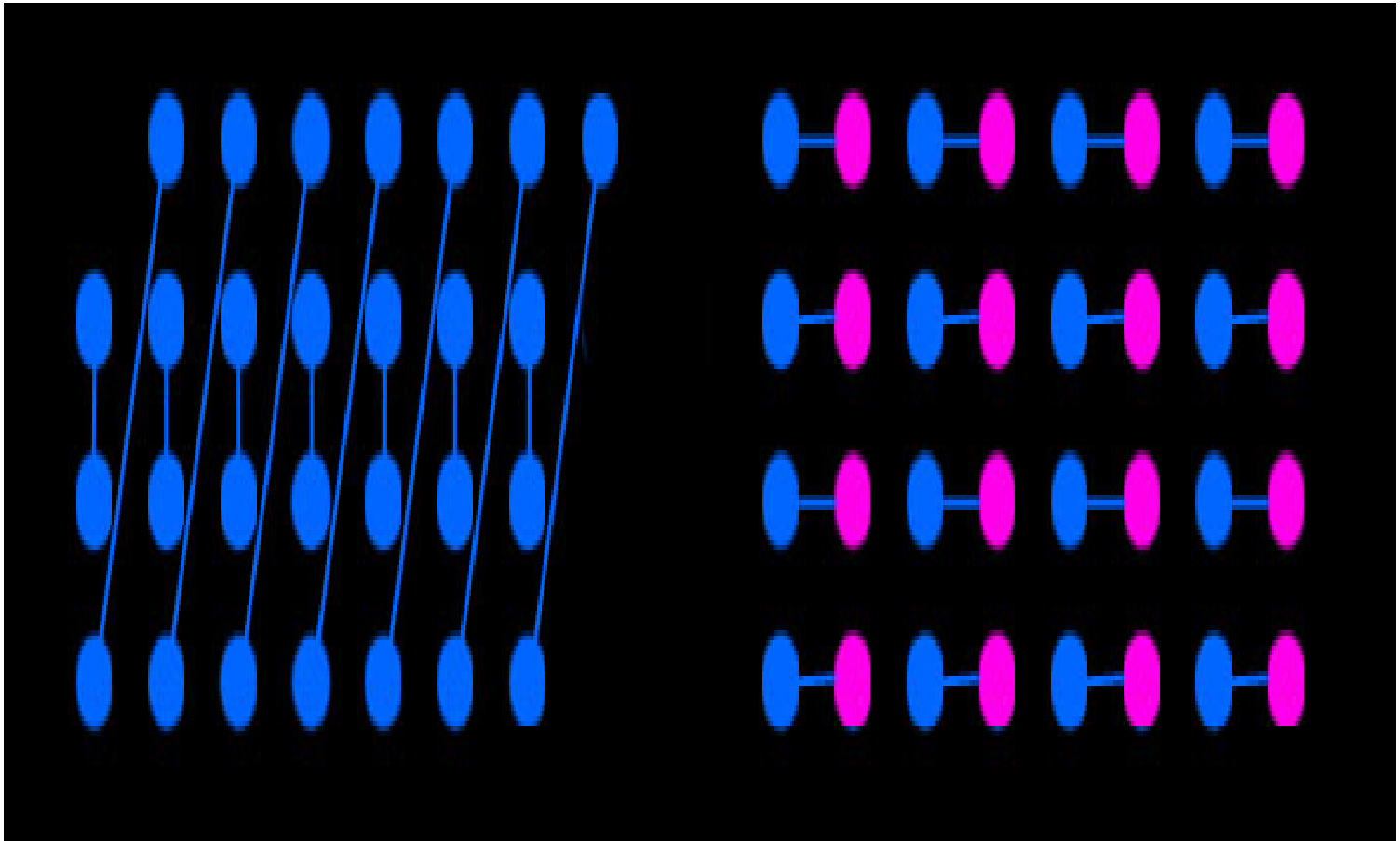
area



symmetry

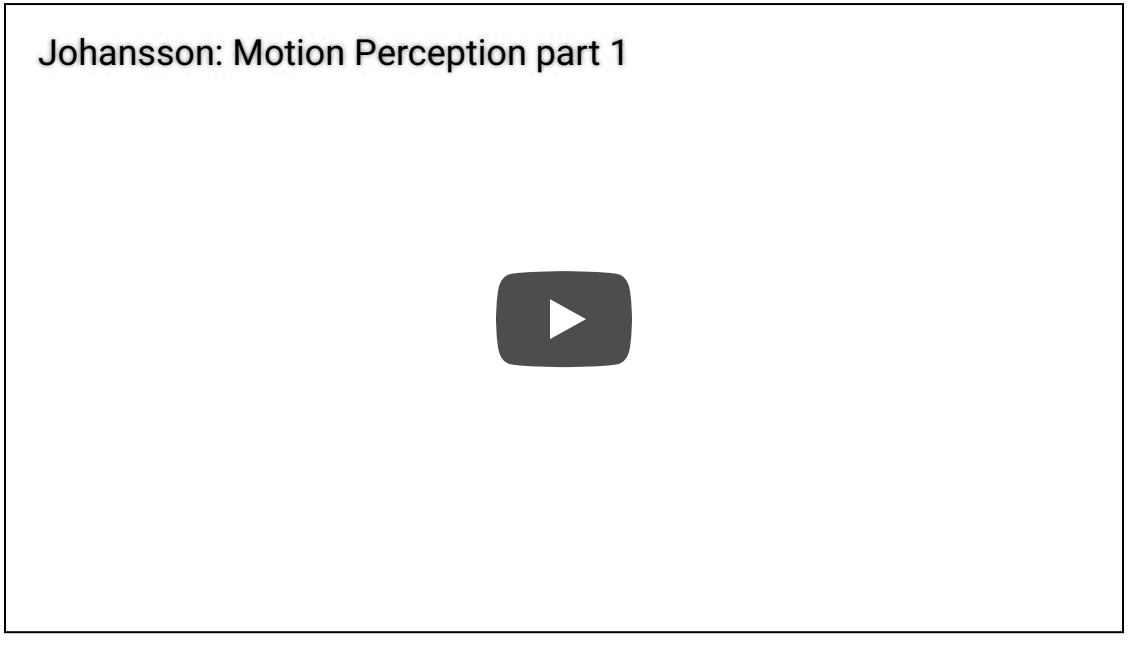


Perceptual grouping



Element connectedness

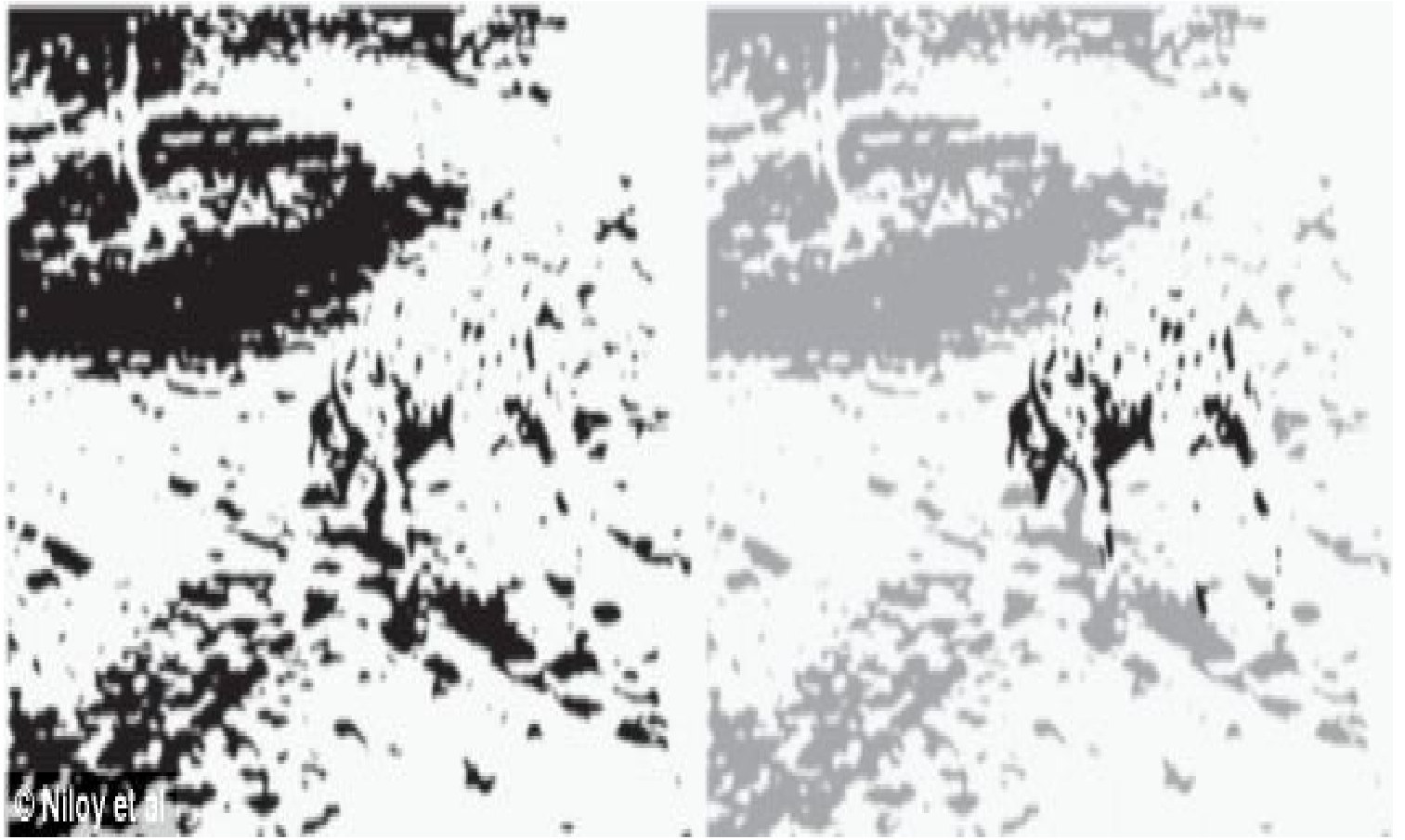
Common region



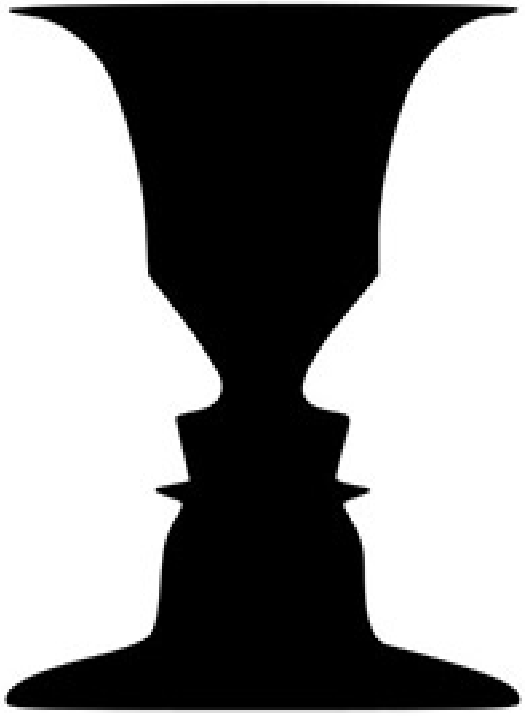
Motion and perceptual organization

Early or late?

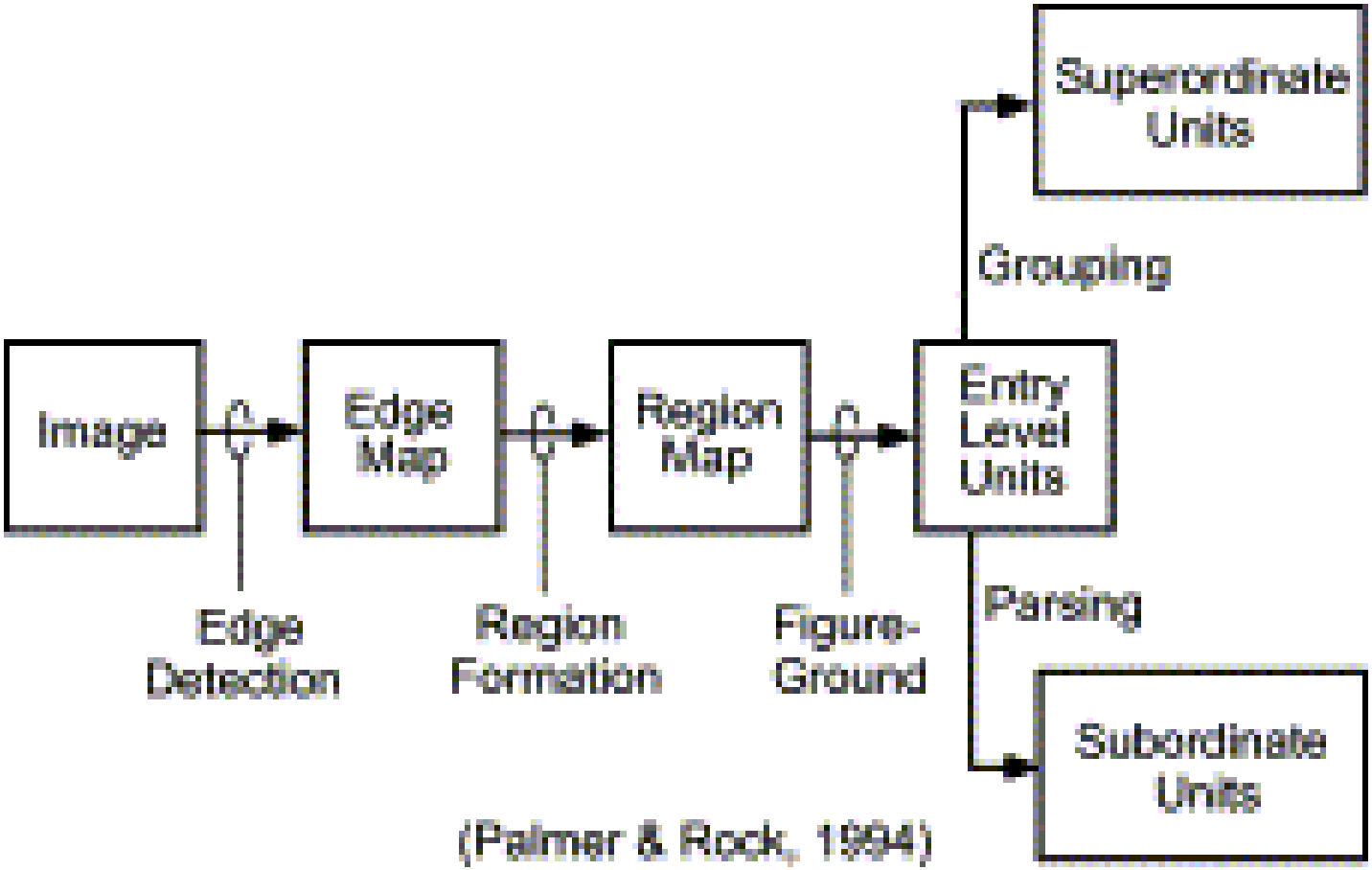
Scene perception

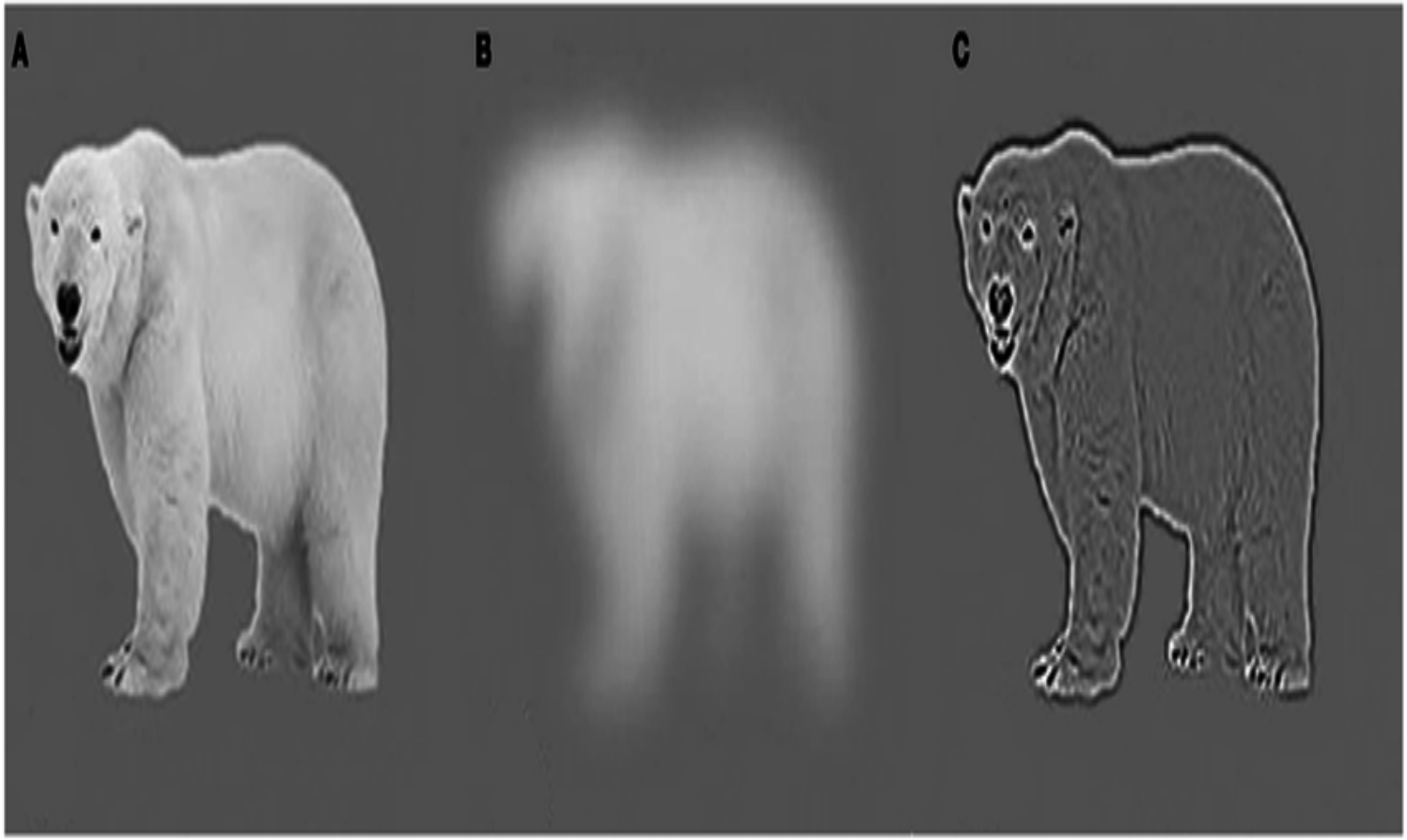


Analyzing regions/camoflage

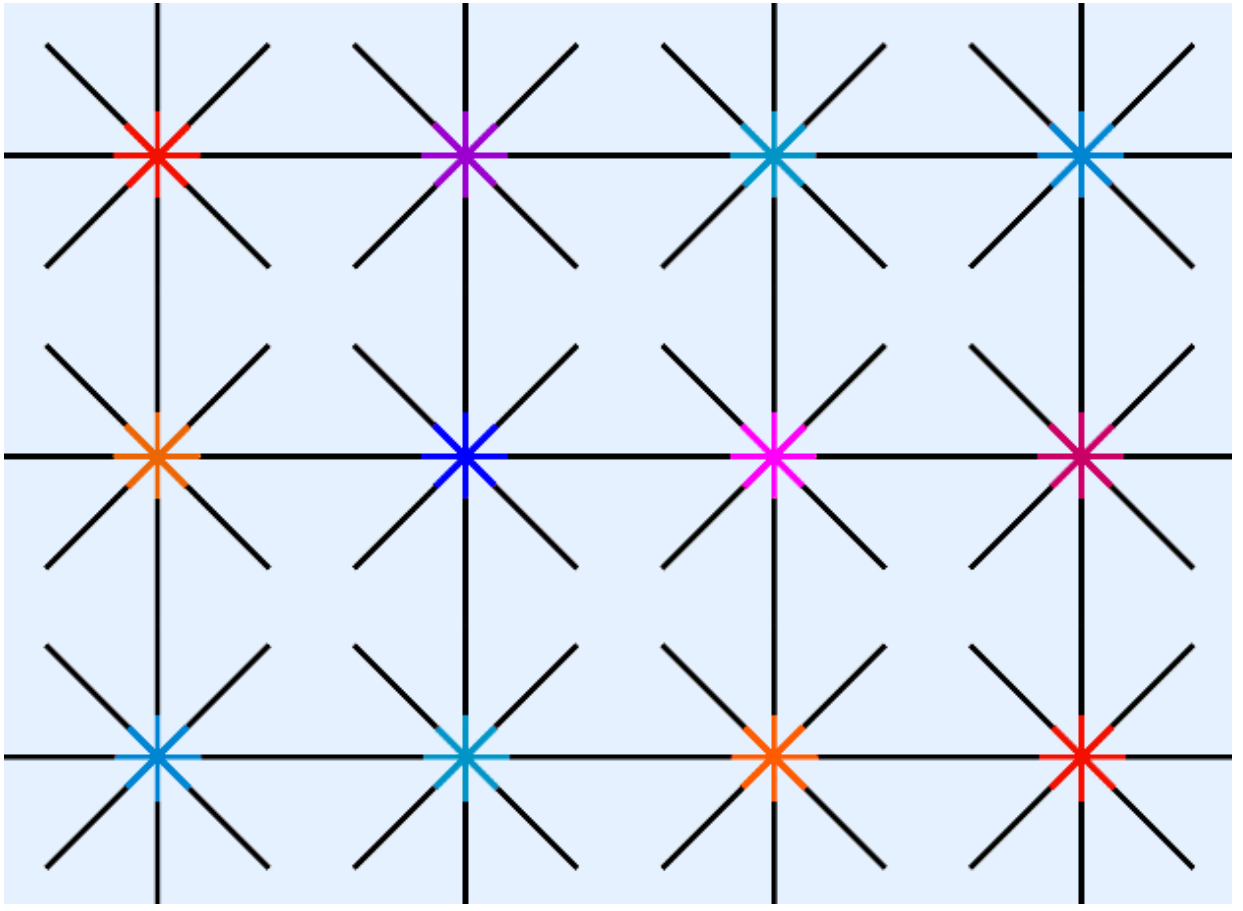


Uniform connectedness: region parsing before grouping? (Palmer & Rock)

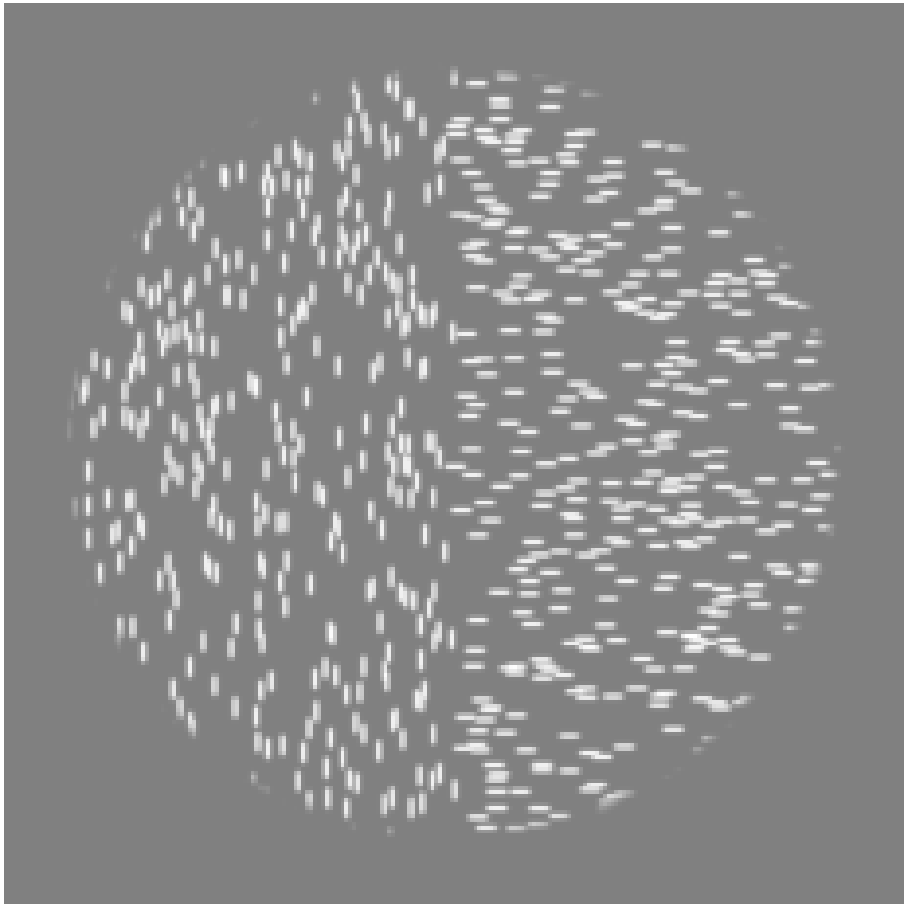

Superordinate Units
Grouping
Image
Edge Map
Region Map
Entry Level Units
Edge Detection
Region Formation
Figure-Ground
Parsing
Subordinate Units
(Palmer & Rock, 1994)



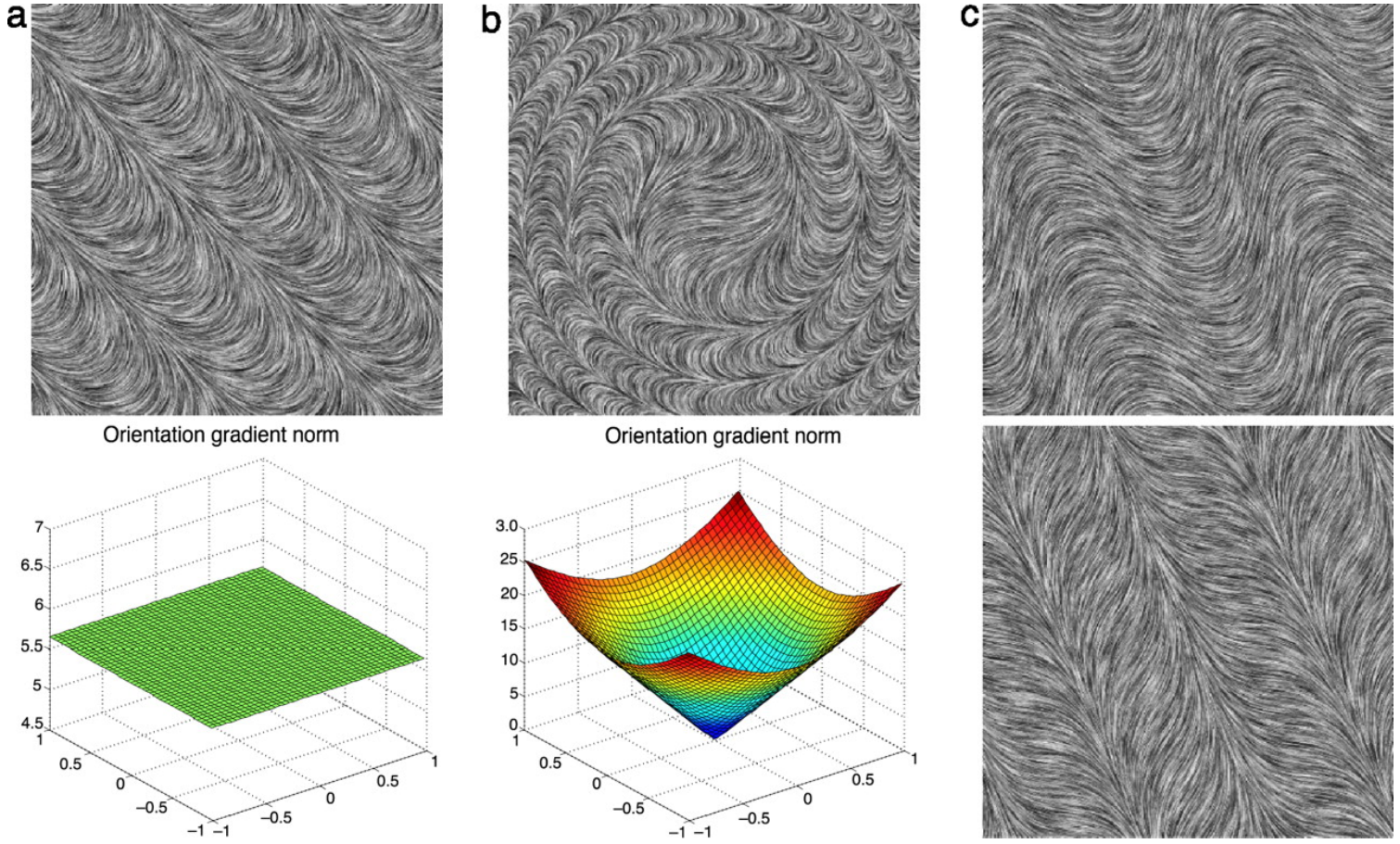
Edge detection through spatial frequency filtering



Illusory edges and spreading



Texture segregation

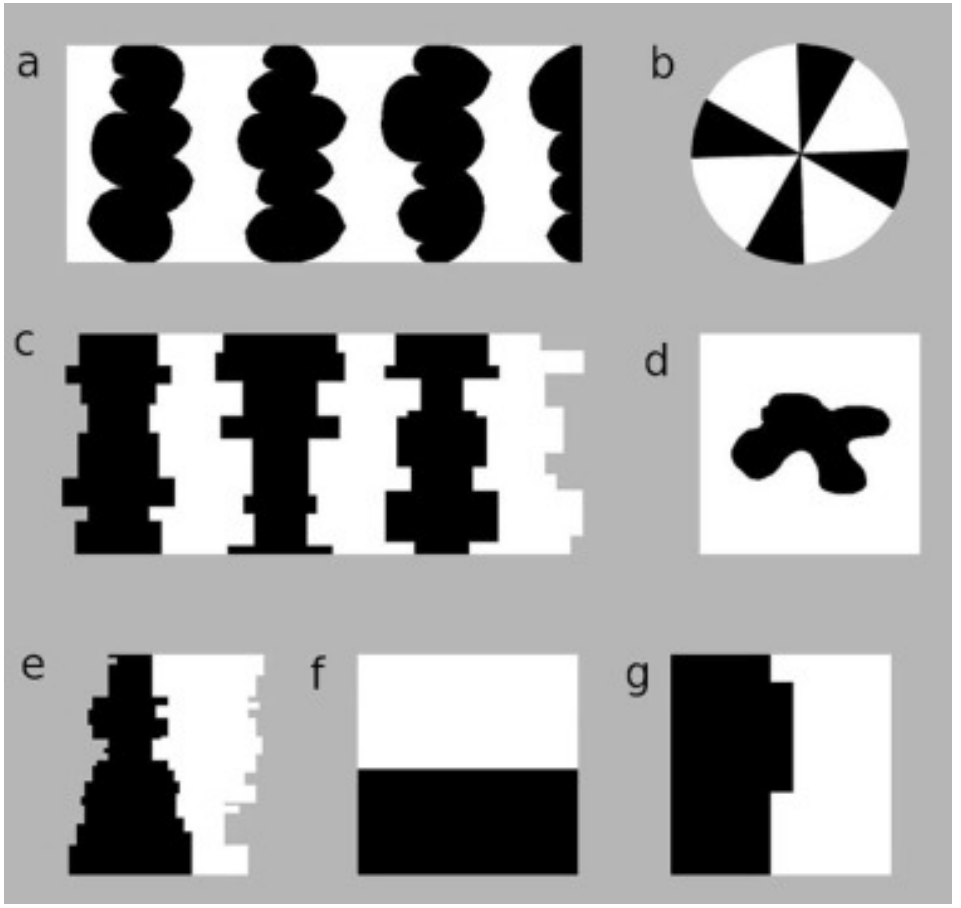


Ben-Shahar, O. (2006). Visual saliency and texture segregation without feature gradient. *Proceedings of the National Academy of Sciences of the United States of America*, *103*(42), 15704–15709. Retrieved from http://dx.doi.org/10.1073/pnas.0604410103

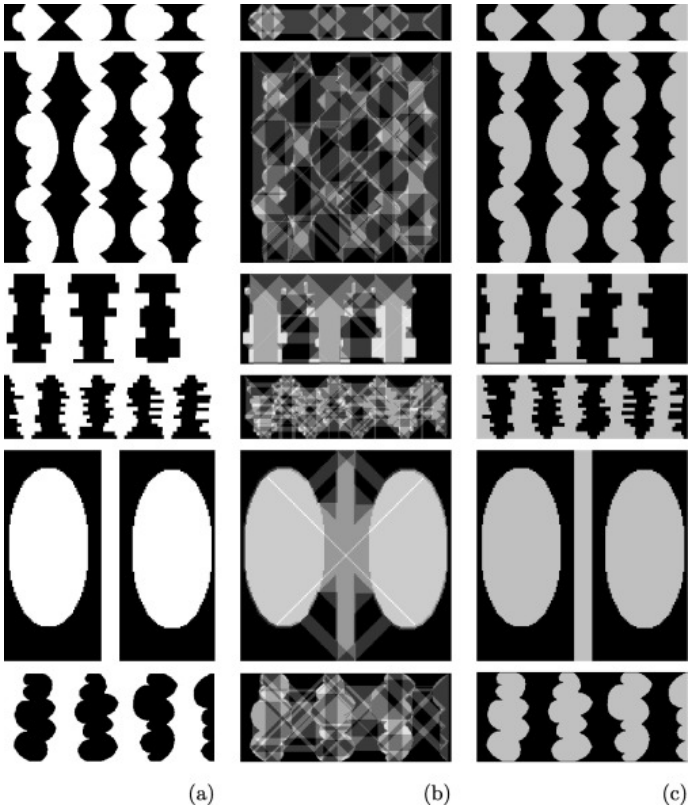
Figure/ground segregation

Figure	Ground
Thinglike	Not thinglike
Closer to observer	Farther from observer
Bounded by contour	Extends behind contour
Shape defined by contour	No shape at contour

Palmer Table 6.3.1

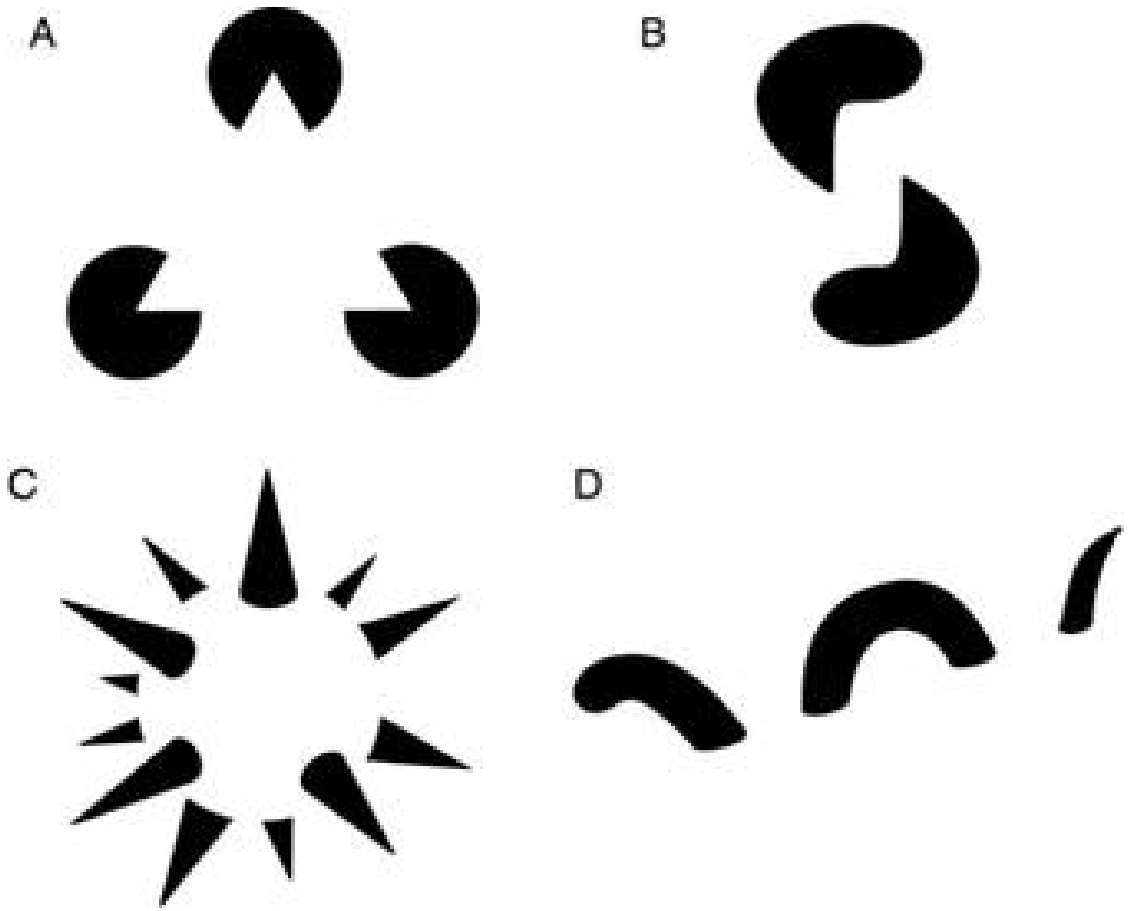


Symmetry, convexity, smallness, bottom-up polarity, lower region, protrusion

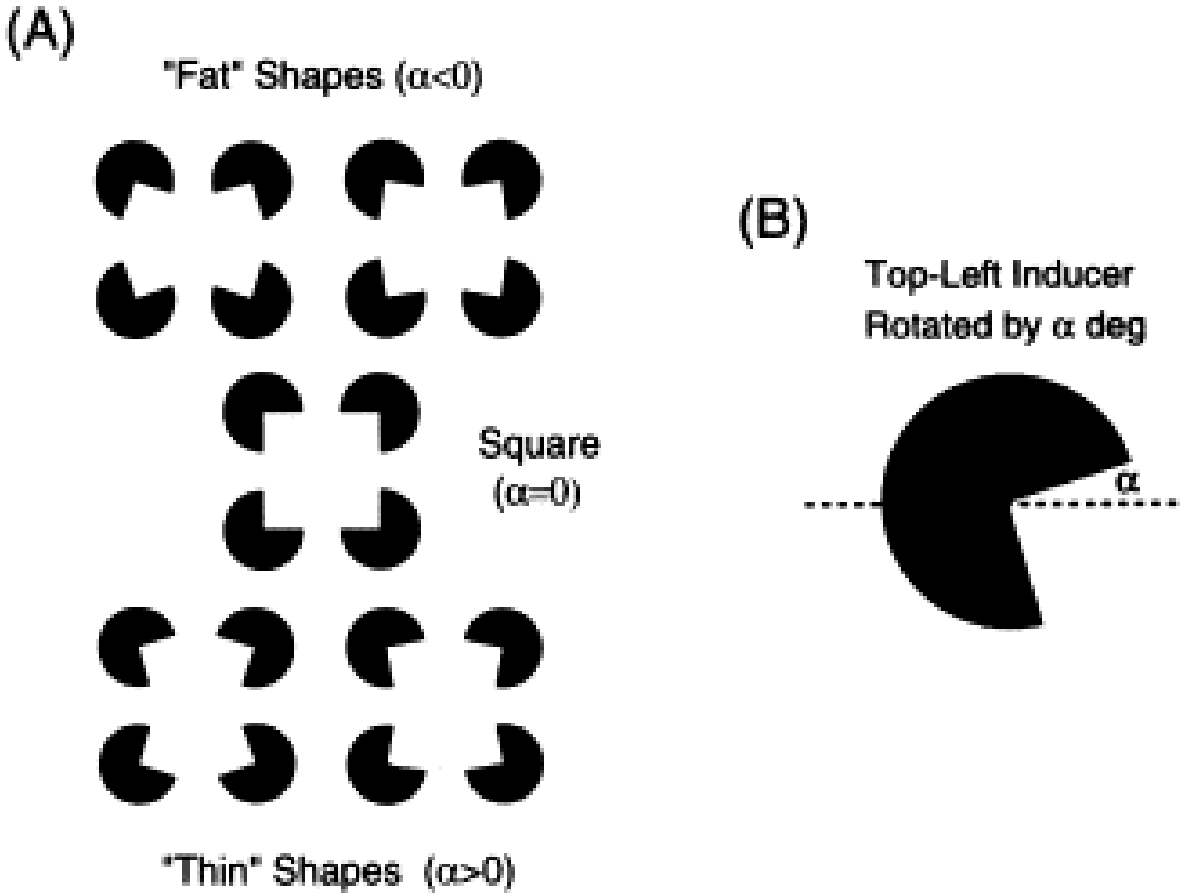


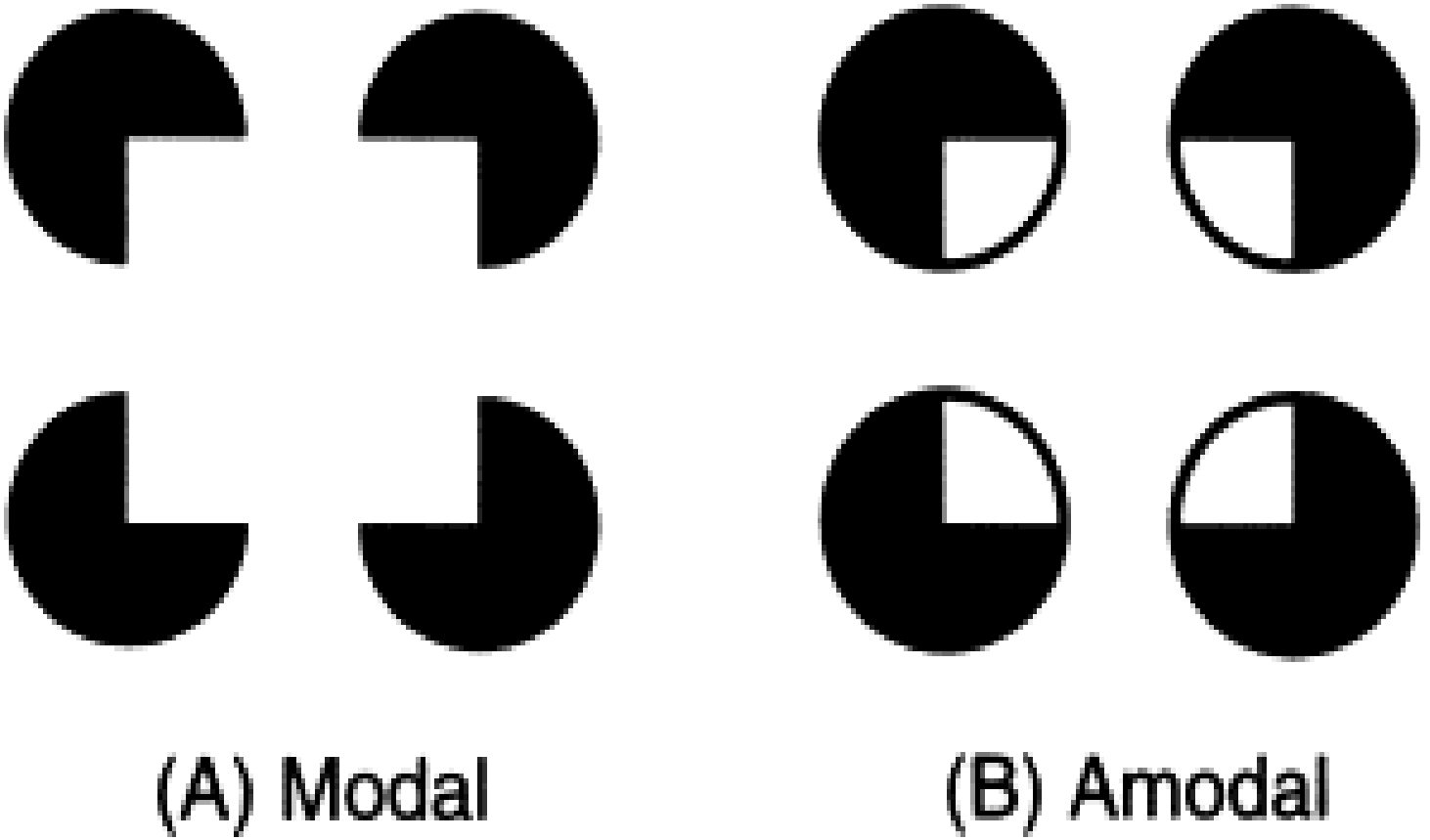
> "Figure–ground segregation can be computed without relying on image contours. Figural status estimates result from a multidirectional linear voting process."

Dimiccoli, M. (2016). Figure-ground segregation: A fully nonlocal approach. *Vision Research*, *126*, 308–317. Retrieved from http://dx.doi.org/10.1016/j.visres.2015.03.007

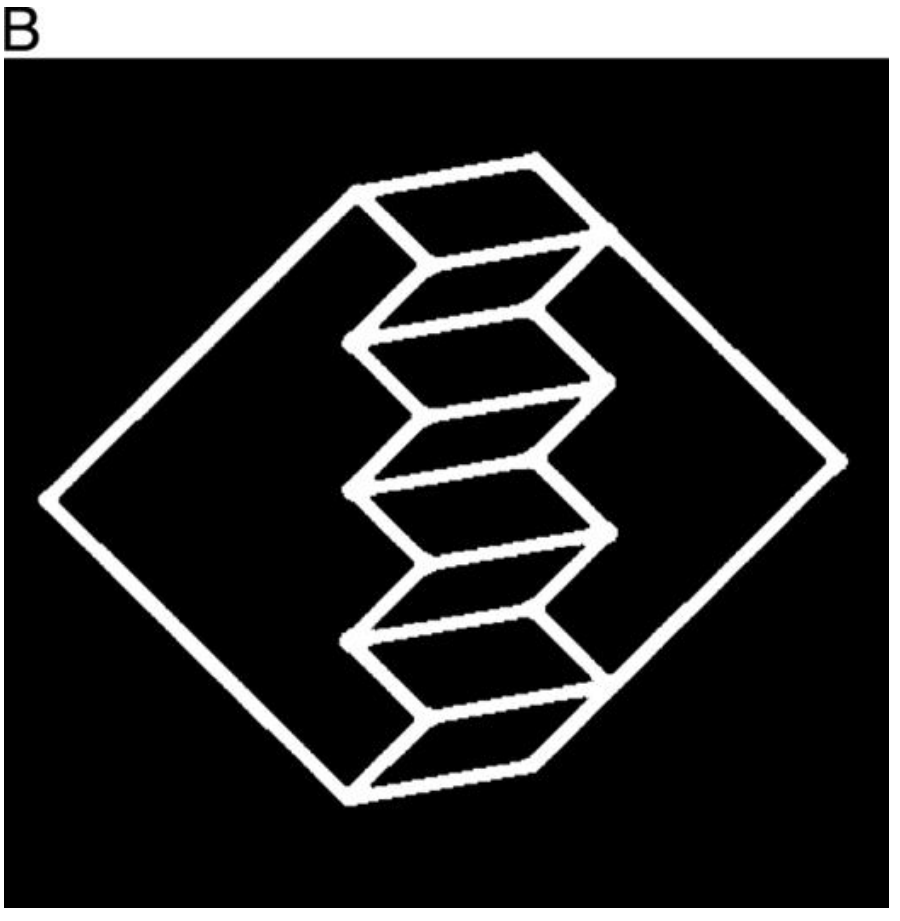


Amodal completion (perception of occluded whole) vs. **modal** completion (perception of unoccluded whole)


(A)
"Fat" Shapes (α<0)
Square
(α=0)
"Thin" Shapes (α>0)
(B)
Top-Left Inducer
Rotated by α deg
α

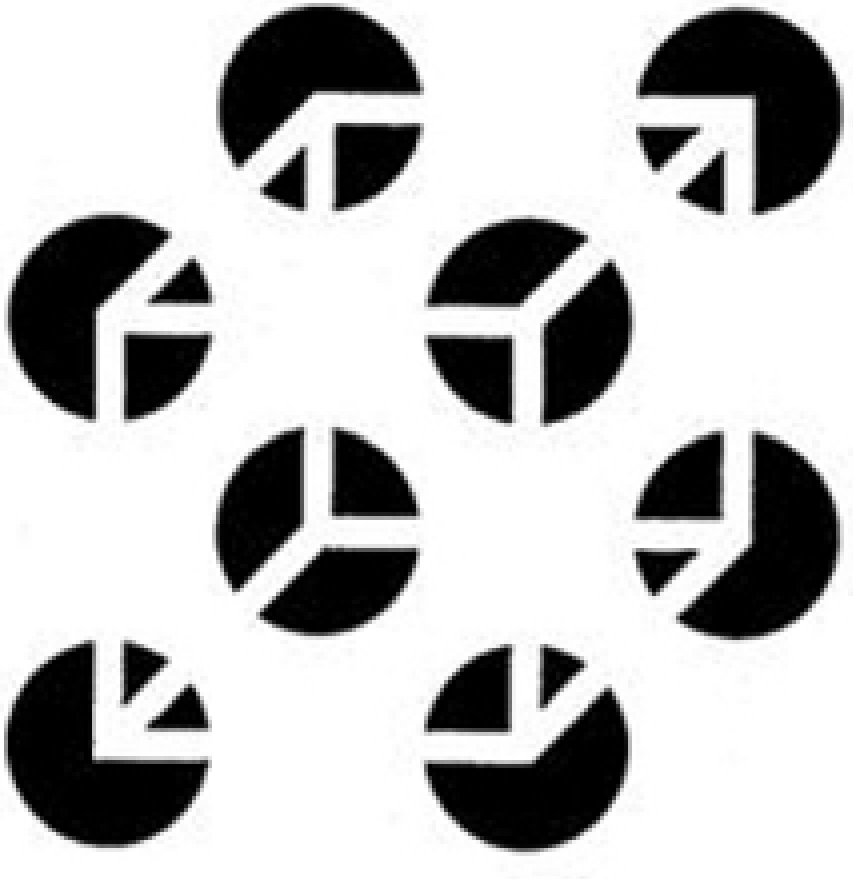


Ringach, D. L., & Shapley, R. (1996). Spatial and temporal properties of illusory contours and amodal boundary completion. *Vision Research*, *36*(19), 3037–3050. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/8917767

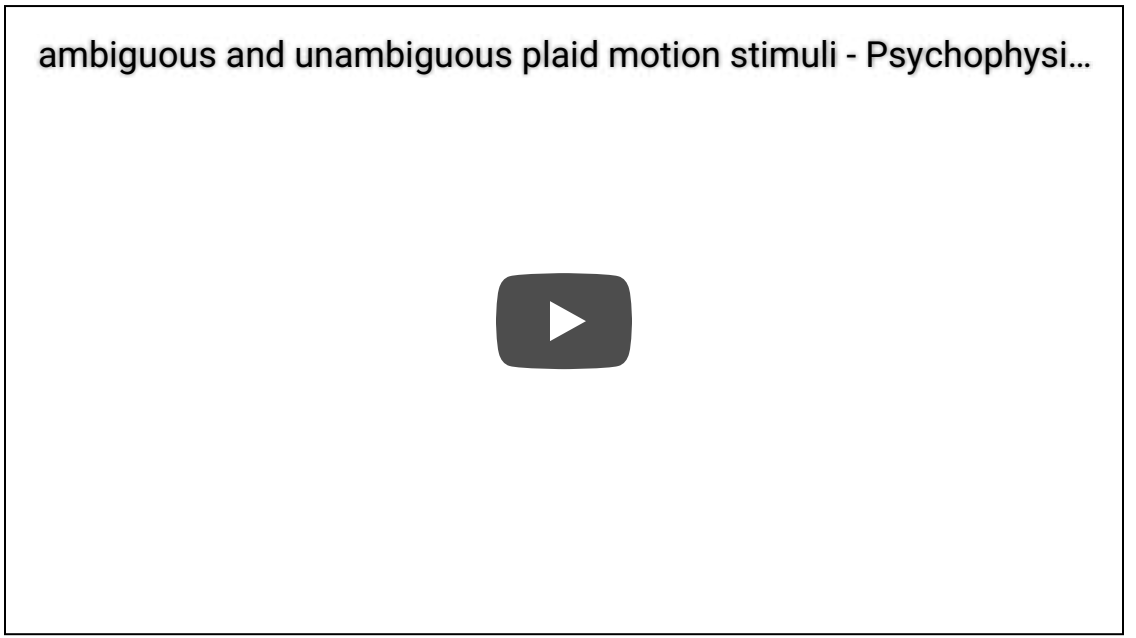


Multi-stable images

Pitts, M. A., Nerger, J. L., & Davis, T. J. R. (2007). Electrophysiological correlates of perceptual reversals for three different types of multistable images. *Journal of Vision*, *7*(1), 6. Retrieved from http://dx.doi.org/10.1167/7.1.6



Necker cube with illusory contours



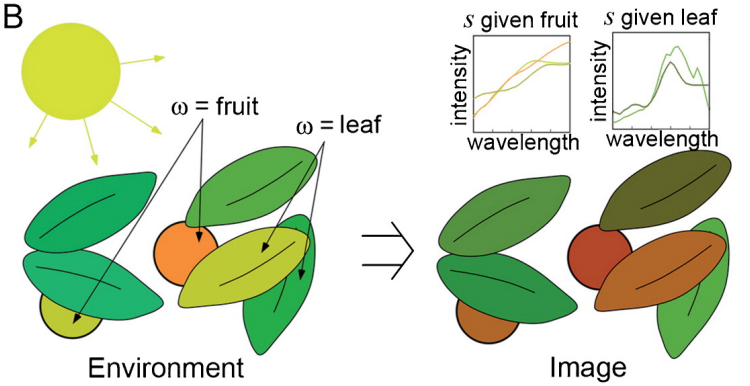
Ambiguous/multi-stable vs. unambiguous plaids

Are there deeper relationships at work here?

A

	Within domain	Across domain		
Environment	$p(\omega)$	$p(\omega,\mathbf{s})$	$p(\omega,\mathbf{z})$	$p(\omega,\mathbf{r})$
Image	$p(\mathbf{s})$	$p(\mathbf{s},\mathbf{z})$	$p(\mathbf{s},\mathbf{r})$	
Neural response	$p(\mathbf{z})$	$p(\mathbf{z},\mathbf{r})$		
Behavior	$p(\mathbf{r})$			

B



Geisler WS. 2008
Annu. Rev. Psychol. 59:167–92

Geisler WS. 2008
Annu. Rev. Psychol. 59:167–92

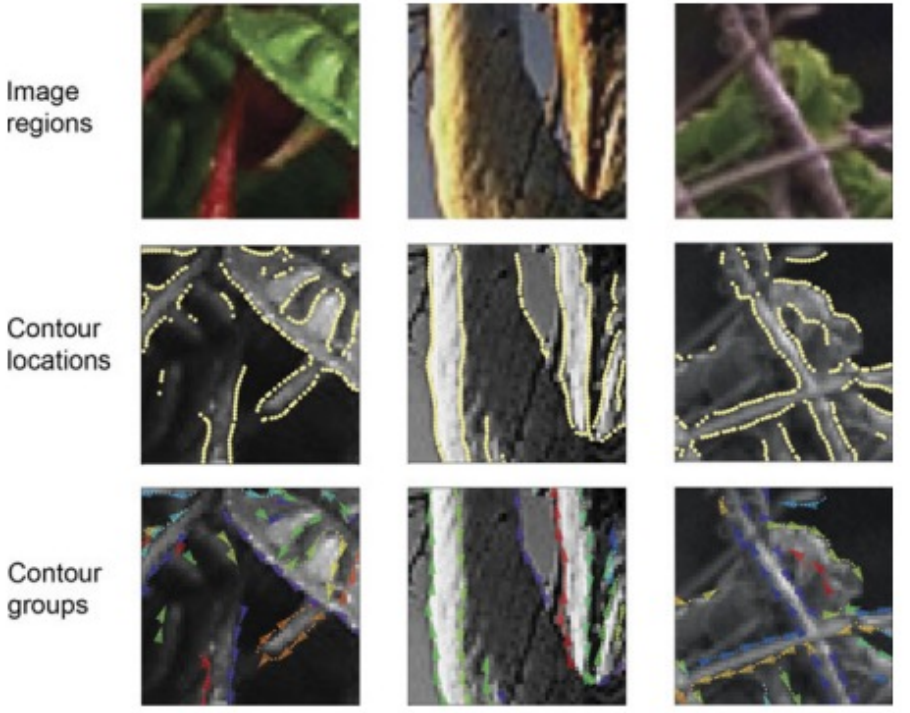


Fig. 2. Contour locations and contour groups for small example patches from three different natural images. The contour locations and contrast polarities were detected by an automatic algorithm. The contour groups were obtained by hand segmentation. The direction of the arrows in the bottom images indicates the contrast polarity of the contour; the different colors represent different groups (note that because colors are randomly selected from a color palette, different groups may have a similar color).

Geisler, W. S., & Perry, J. S. (2009). Contour statistics in natural images: Grouping across occlusions. Visual neuroscience, 26(1), 109–121. Cambridge University Press.

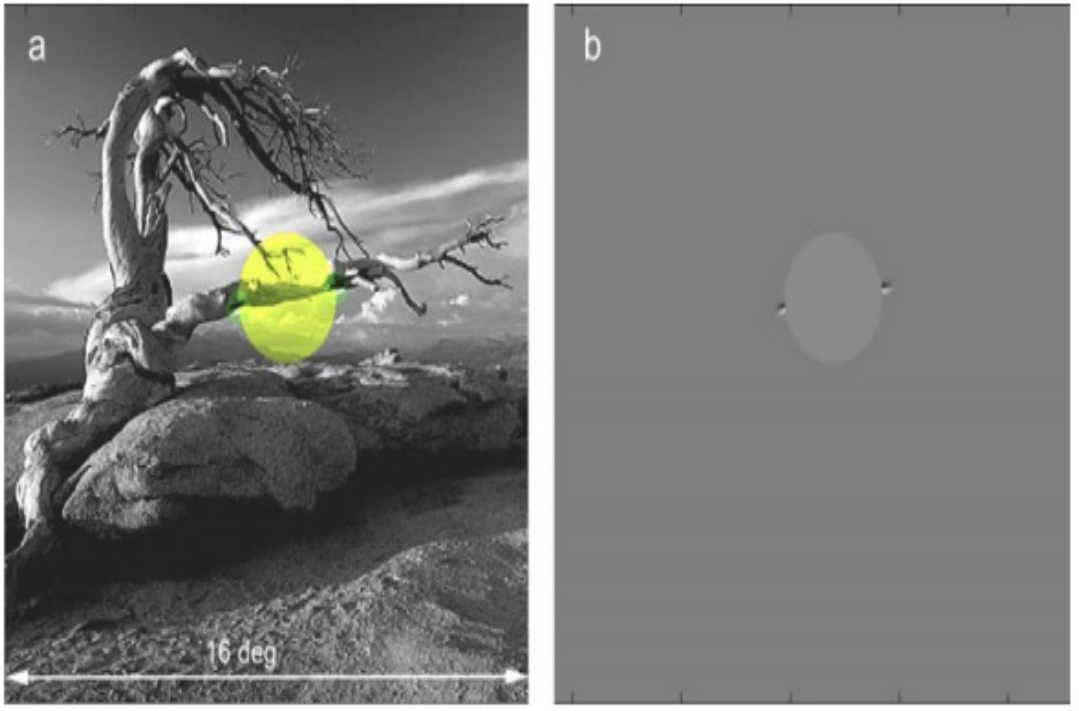


Fig. 4. (Color online) Contour occlusion task stimuli. The largest occluder diameter was 90 pixels (shown here), corresponding 3 deg of visual angle.

Geisler, W. S., & Perry, J. S. (2009). Contour statistics in natural images: Grouping across occlusions. Visual neuroscience, 26(1), 109–121. Cambridge University Press.

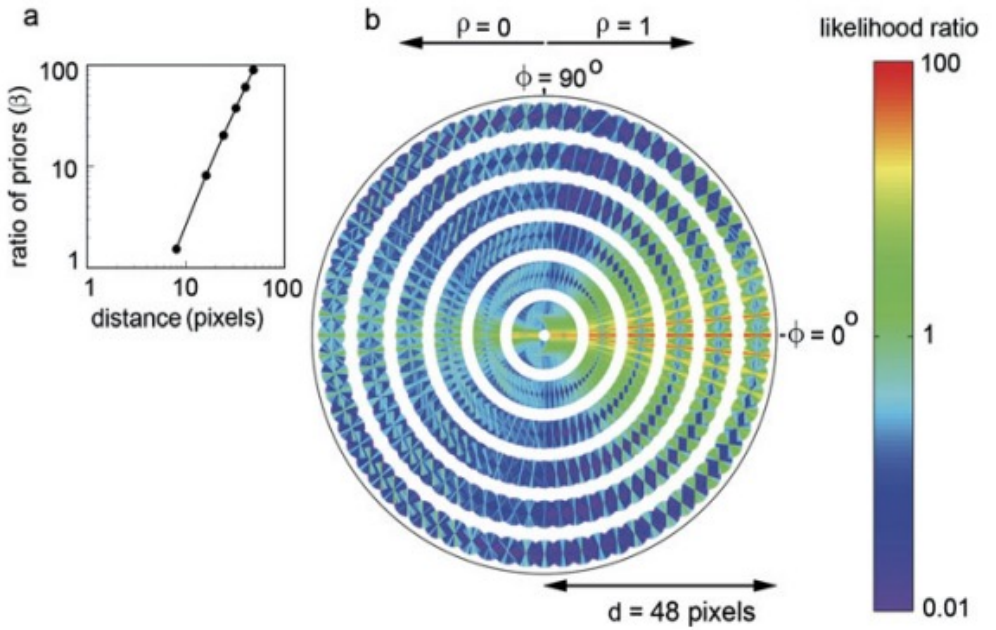


Fig. 6. Across-domain co-occurrence statistics of contour elements in natural images. (**a**) Ratio of the prior probabilities that a pair of contour elements belongs to different versus the same physical source, as a function of distance between the pair of elements. (**b**) Plot of the likelihood ratio for a given relationship between pairs of contour elements. A likelihood ratio greater then 1.0 means (given equal priors) that it is more likely that the elements belong to the same physical contour; a ratio less than 1.0 means that it is more likely that the elements belong to different physical contours. [For each distance, direction, and polarity, the orientation difference bins (line segments) are drawn in rank order starting from the lowest likelihood; thus, the highest likelihoods are the most visible in the plot.]

Geisler, W. S., & Perry, J. S. (2009). Contour statistics in natural images: Grouping across occlusions. Visual neuroscience, 26(1), 109–121. Cambridge University Press.

Break time

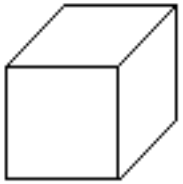
Discussion of Biederman (1987)

Principles of "non-accidentalness"

1. Collinearity
2. Curvilinearity
3. Symmetry
4. Parallel curves
5. Vertices

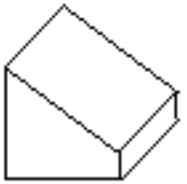
Ames chair illusion illustrates implicit "principle" of co-termination

Cube



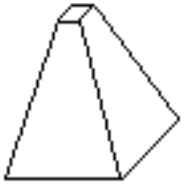
Straight Edge
Straight Axis
Constant

Wedge



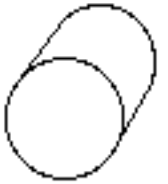
Straight Edge
Straight Axis
Expanded

Pyramid



Straight Edge
Straight Axis
Expanded

Cylinder

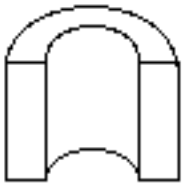


Curved Edge
Straight Axis
Constant

Barrel

Curved Edge
Straight Axis
Exp & Cont

Arch

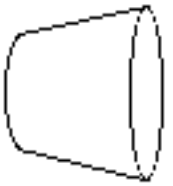


Straight Edge
Curved Axis
Constant

Cone

Curved Edge
Straight Axis
Expanded

Expanded
Cylinder



Curved Edge
Straight Axis
Expanded

Handle

Curved Edge
Curved Axis
Constant

Expanded
Handle

Curved Edge
Curved Axis
Expanded

Edge	Symmetry	Size	Axis
Straight or Curved	Rot + Ref; Ref; Asymm	Constant; Expanded; Expand & Contract	Straight or Curved

Next time...

Size, shape, orientation, & position

Slides created via the R package **xaringan**. Rendered HTML and supporting files are pushed to GitHub where GitHub's 'pages' feature is used to host and serve the course website.