The influence of partial occlusion on shape recognition

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The influence of partial occlusion on shape recognition

Gunnar Schmidtmann
“...information is concentrated along contours at those points on a contour at which its direction changes most rapidly...”

“Common objects may be represented with great economy, and fairly striking fidelity, by copying the points at which their contours change direction maximally, and then connecting these points appropriately with a straightedge.”

Shape recognition: convexities, concavities and things in between

Gunnar Schmidtmann, Ben J. Jennings & Frederick A. A. Kingdom
Stimuli

compound radial frequency patterns

$\omega_1 = 3$  
$\omega_2 = 5$  
$\omega_3 = 8$

$RF_{\text{compound}} = r_{\text{mean}}(1+A_1\sin(\omega_1\theta+\varphi_1)+A_2\sin(\omega_2\theta+\varphi_2)+A_3\sin(\omega_3\theta+\varphi_3))$

- $r_{\text{mean}}$: mean radius of underlying circle (=100 Pixel)
- $A$: modulation amplitude (=0.1)
- $\omega_1$: radial frequency
- $\theta$: polar angle
- $\varphi_1$: phase / orientation (random)

$1 2 5$  
$2 3 6$  
$3 5 8$
Stimuli

convexities  concavities  intermediate
Stimuli
Paradigm

Reference

300 ms

400 ms

300 ms

300 ms

Target
Distractor

400 ms
Results

convexities

concavities

intermediate

2-3-4

Proportion correct vs. Segment Length

Proportion correct vs. Segment Length

Proportion correct vs. Segment Length
New Experiment - Partial Occlusion
Stimuli

convexities

concavities

intermediate
Partial Occlusion

No occlusion 16.7% occlusion 33% occlusion 50% occlusion
Results – no occlusion

convexities

concavities

intermediate
Results – 16.7% occlusion
Results – 33% occlusion

- Convexities
- Concavities
- Intermediate
Results – 50% occlusion

convexities

concavities

intermediate
Results – combined

convexities

concavities

intermediate

no occlusion
16.7% occlusion
33% occlusion
50% occlusion

no occlusion
16.7% occlusion
33% occlusion
50% occlusion

no occlusion
16.7% occlusion
33% occlusion
50% occlusion
Model – Schmidtmann et al. (2015)
Model – Schmidtmann et al. (2015)
Model – Schmidtmann et al. (2015)
Proposed Model Idea

Occluded Reference Shape

Distractor Shape

Target Shape
Proposed Model Idea

Occluded Reference Shape

Distractor Shape

Target Shape
Proposed Model Idea

Occluded Reference Shape

Distractor Shape

Target Shape
Summary

• Performance for convex features is superior to the other shape features and independent of segment length, replicating Schmidtmann et al. (2015)

• Points at the location of convex curvature maxima are sufficient to extract shape information

• Performance is only significantly impaired when 50% of the shape is occluded

• Results demonstrate the importance of convexities maxima for shape encoding, and the flexibility of the visual system to deal with partially occluded shapes
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Gunnar Schmidtmann