The influence of partial occlusion on shape recognition

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Background

"...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."

Attneave, F. (1954). Some informational aspects of visual perception. *Psychological review*, *61*(3), 183–193.

Previous work

SCIENTIFIC REP⚙RTS

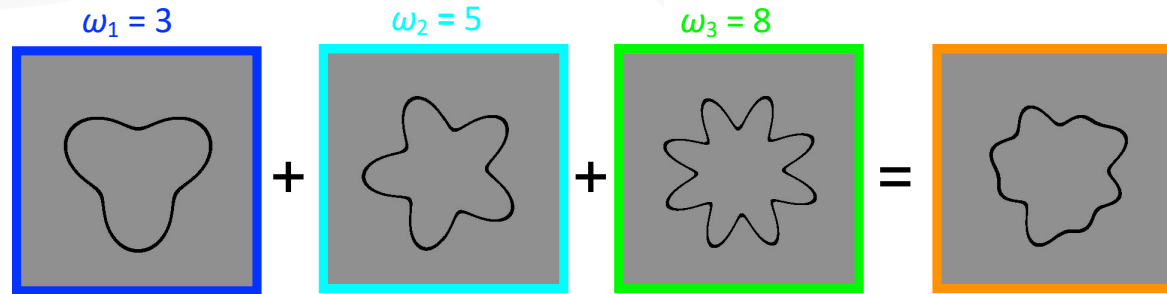**OPEN** **Shape recognition: convexities, concavities and things in between**

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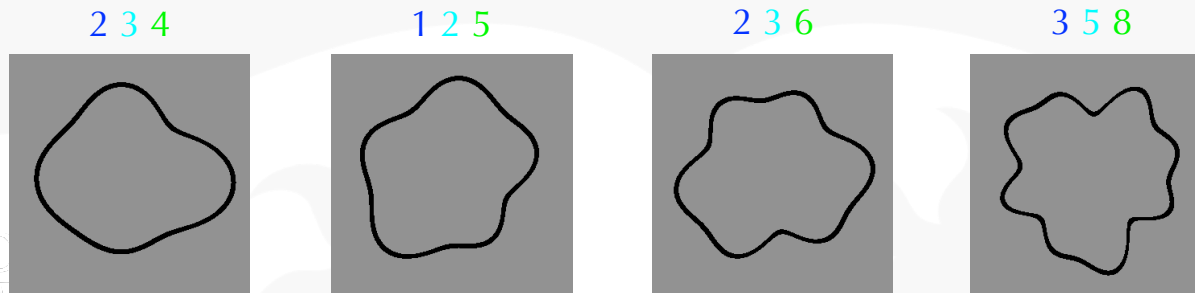
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Stimuli

compound radial frequency patterns
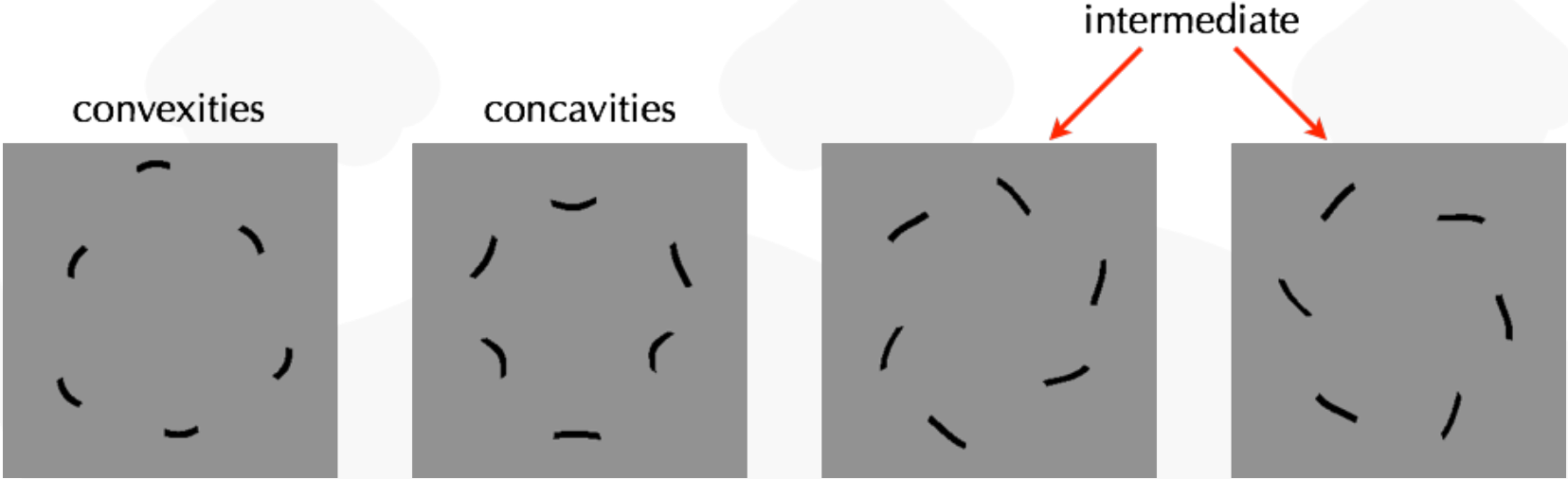
$\omega_1 = 3$ $\omega_2 = 5$ $\omega_3 = 8$

$RF_{compound} = r_{mean}(1 + A_1\sin(\omega_1\theta + \varphi_1) + A_2\sin(\omega_2\theta + \varphi_2) + A_3\sin(\omega_3\theta + \varphi_3))$
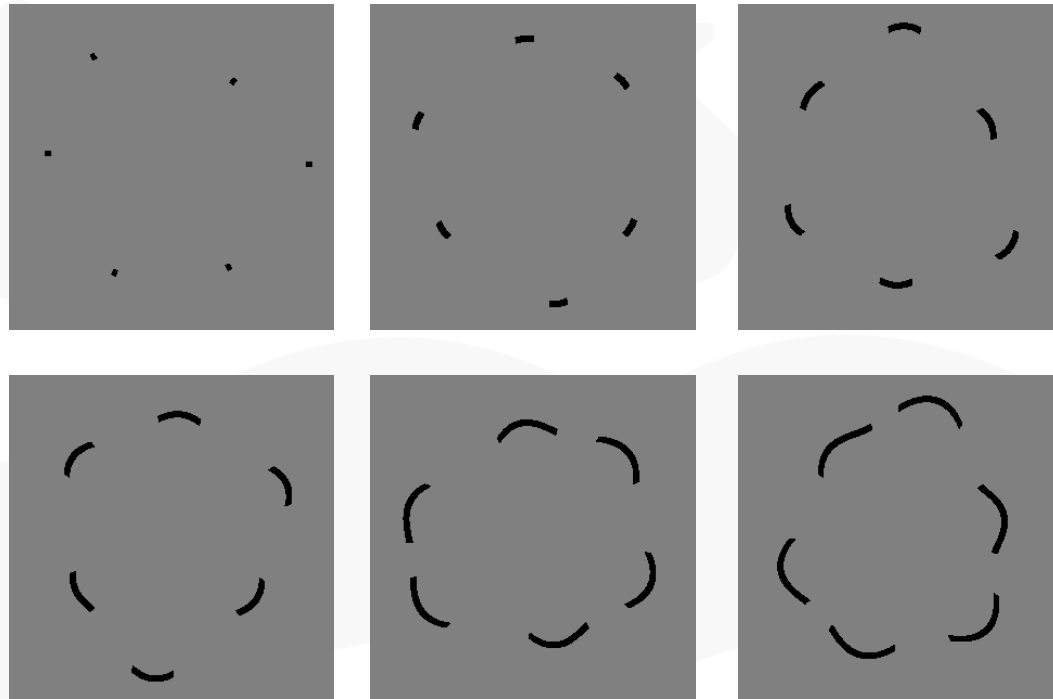
- r_{mean}: mean radius of underlying circle (=100 Pixel)
- A: modulation amplitude (=0.1)
- ω_1: radial frequency
- θ: polar angle
- φ_1: phase / orientation (random)

2 3 4   1 2 5   2 3 6   3 5 8

Stimuli

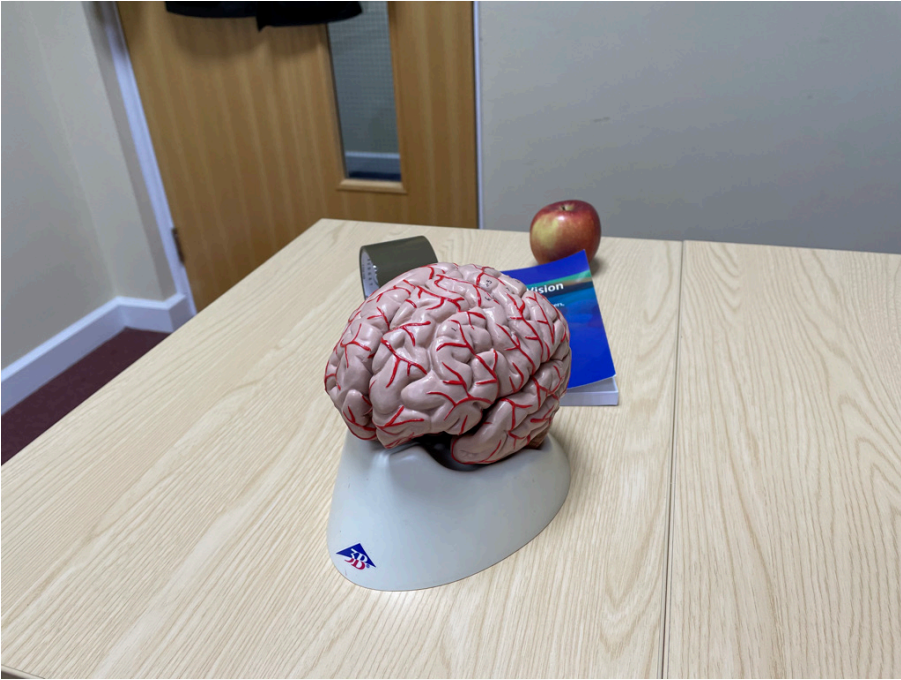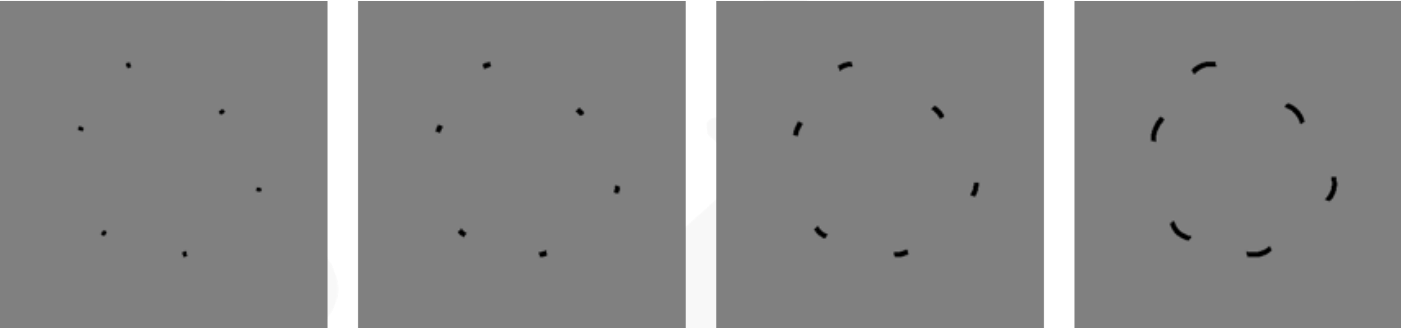convexities   concavities   intermediate

Stimuli

Paradigm
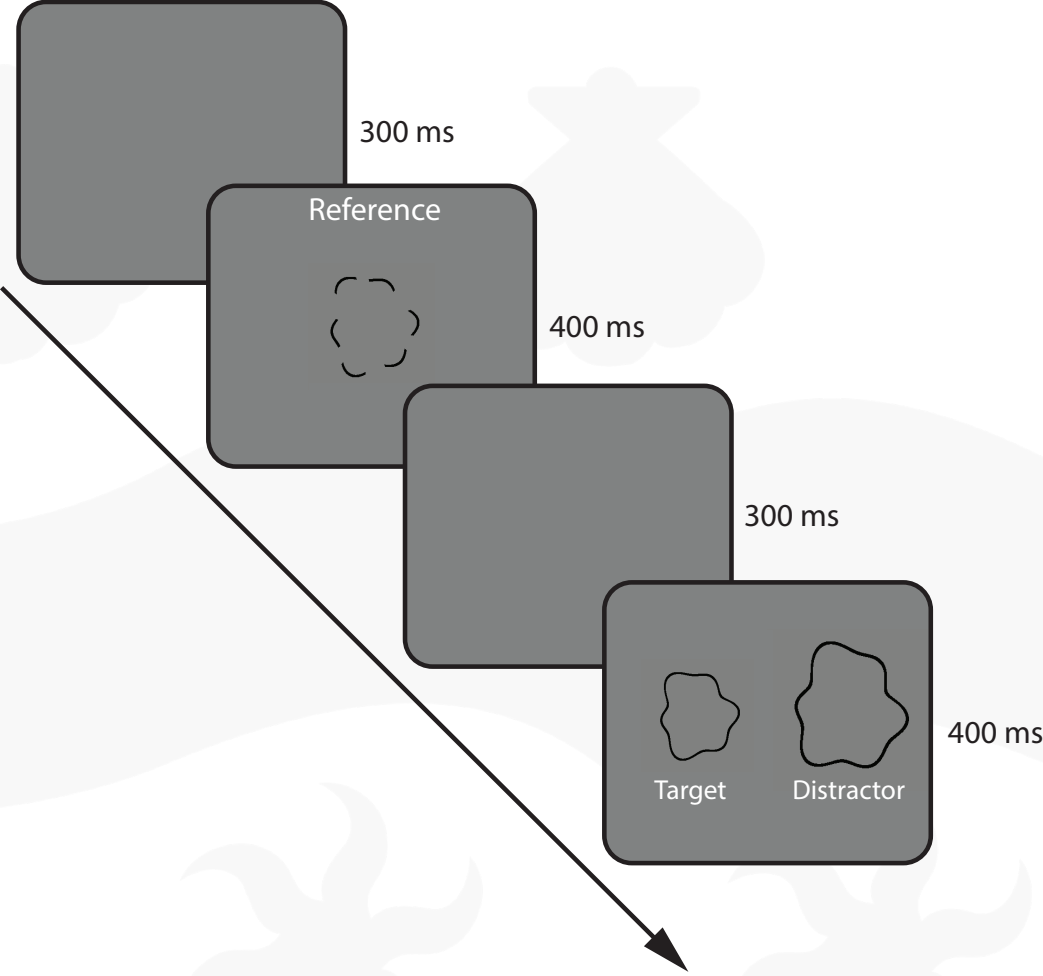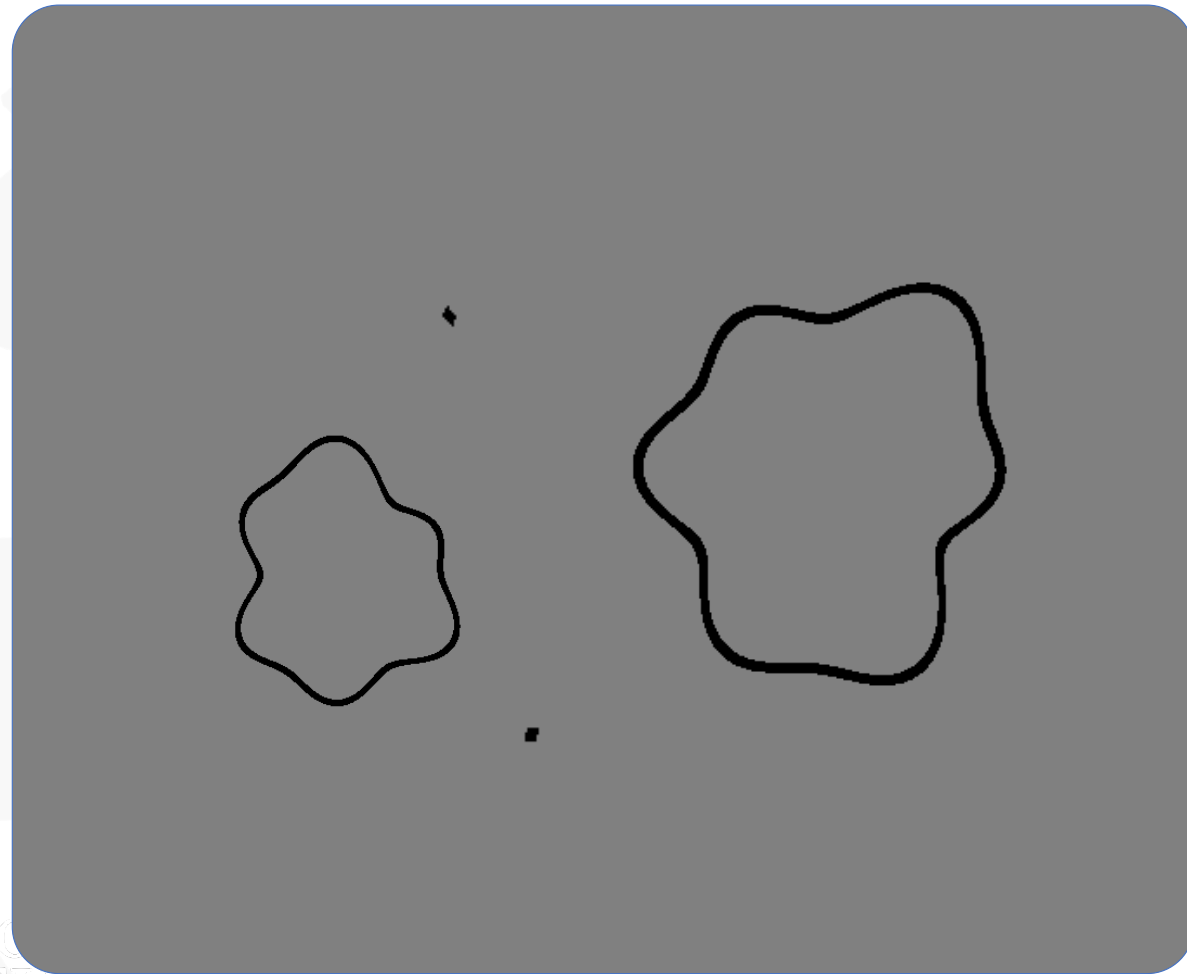
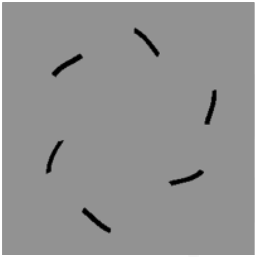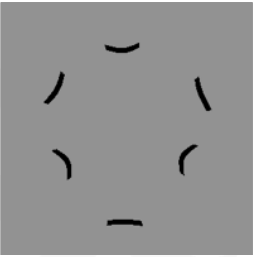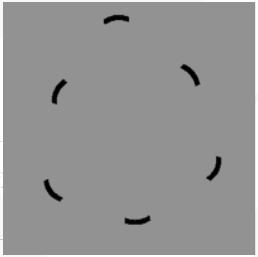# Demo

Demo
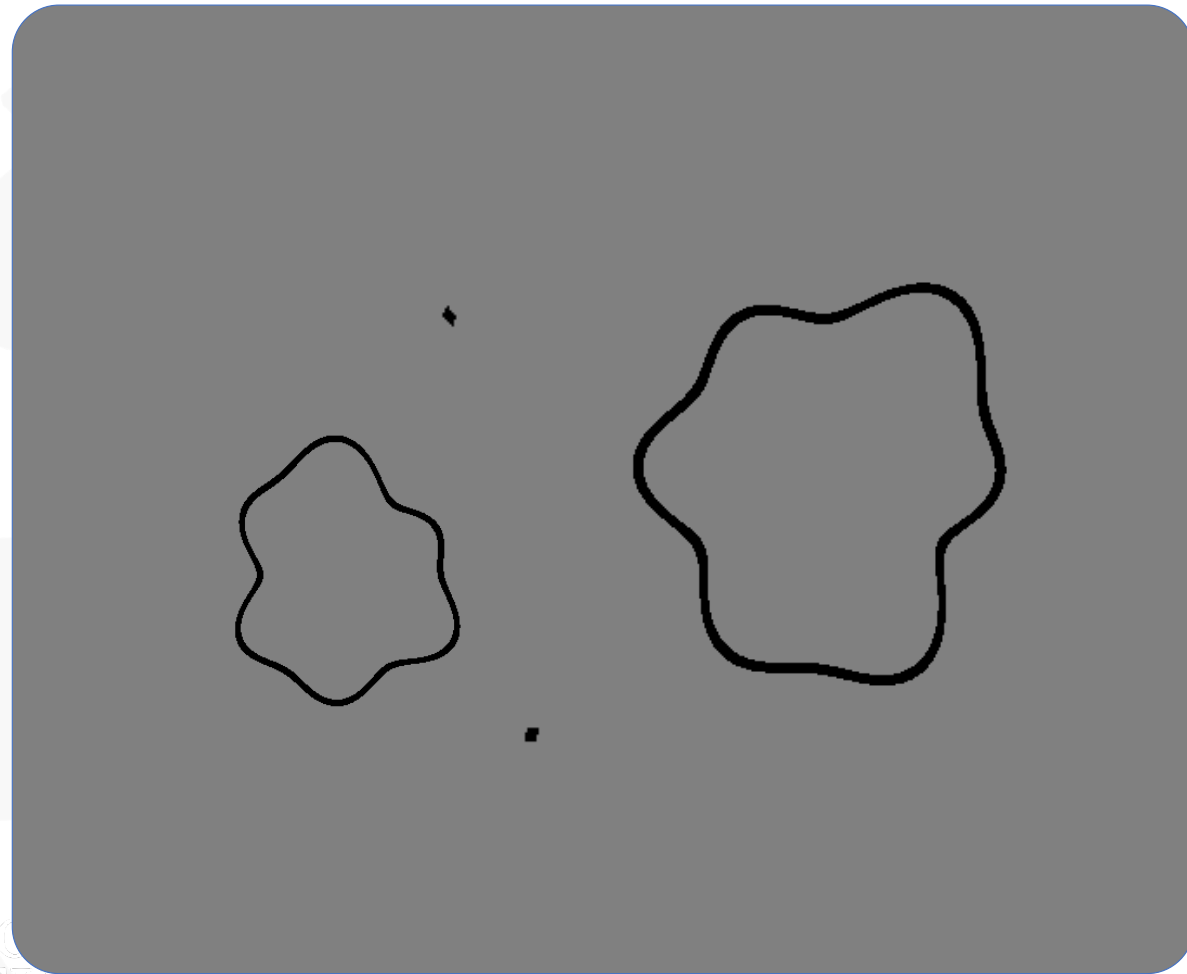
Results
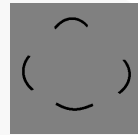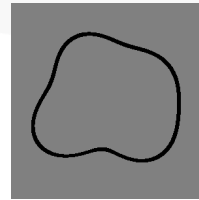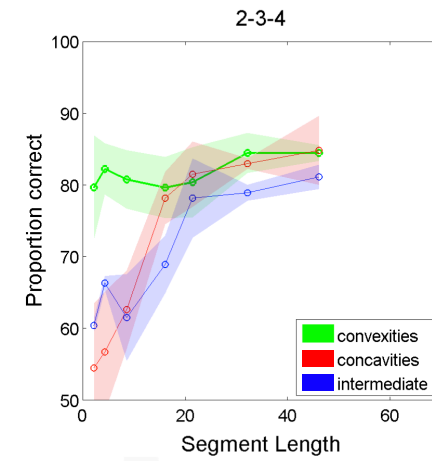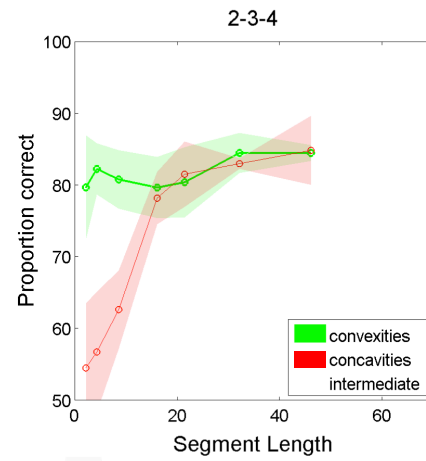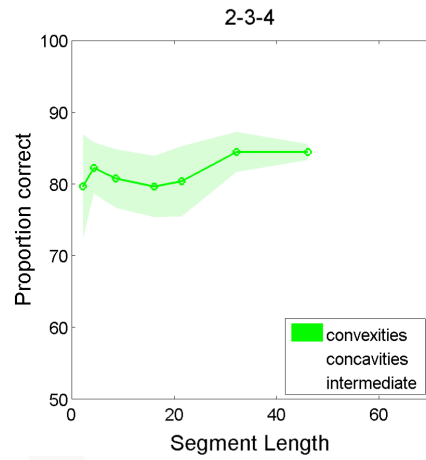
Model Results
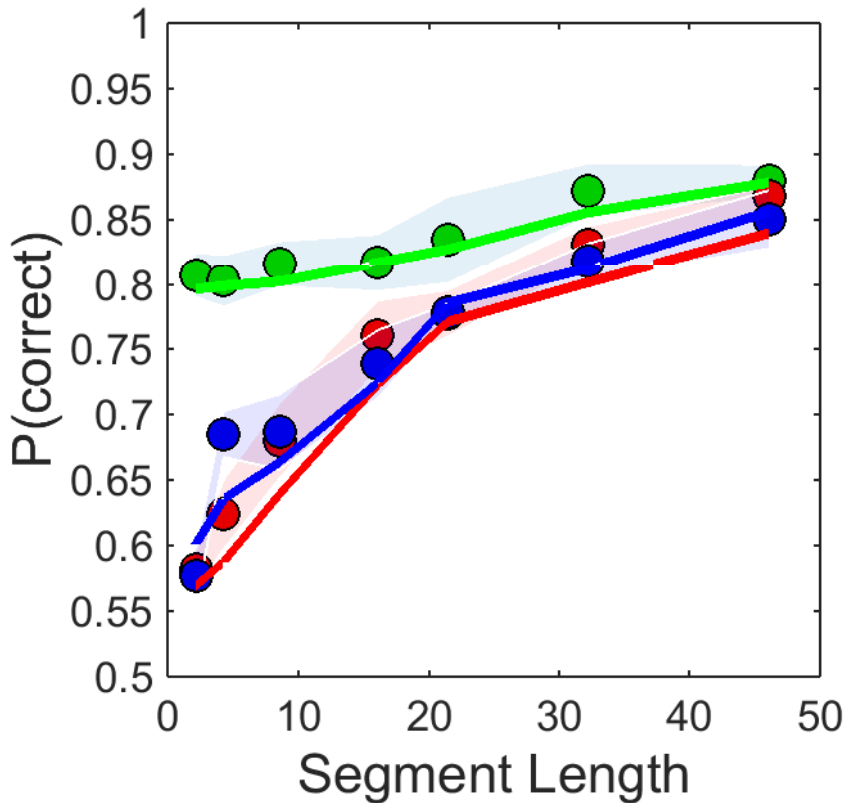
New Experiment - Partial Occlusion

Stimuli

convexities concavities intermediate

Partial Occlusion
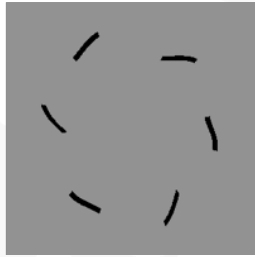
No occlusion   **16.7% occlusion**   **33% occlusion**   **50% occlusion**
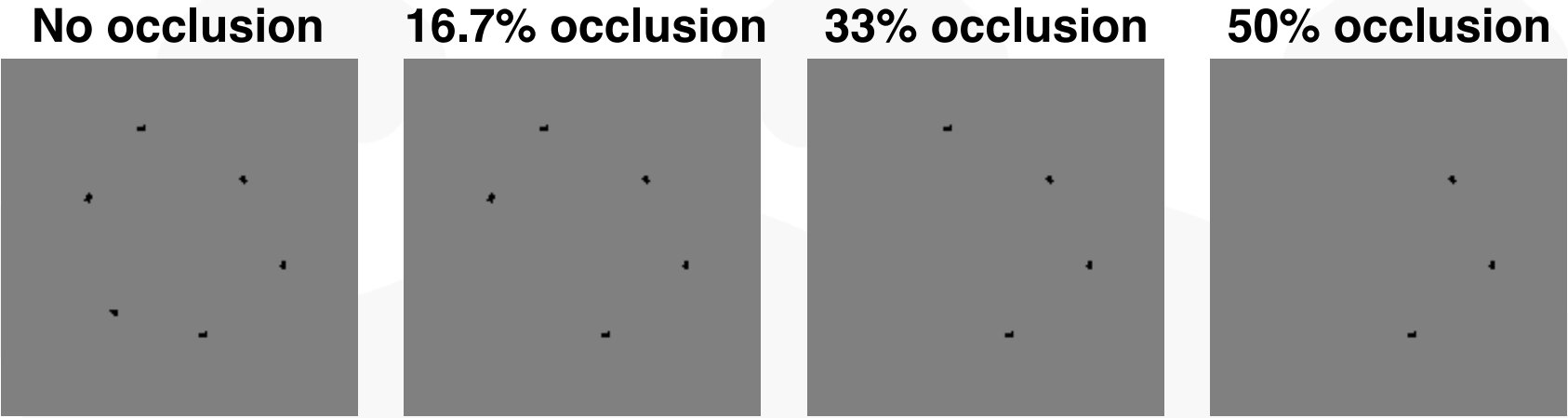
Results – no occlusion
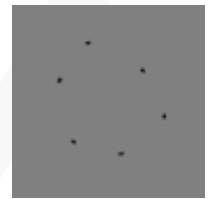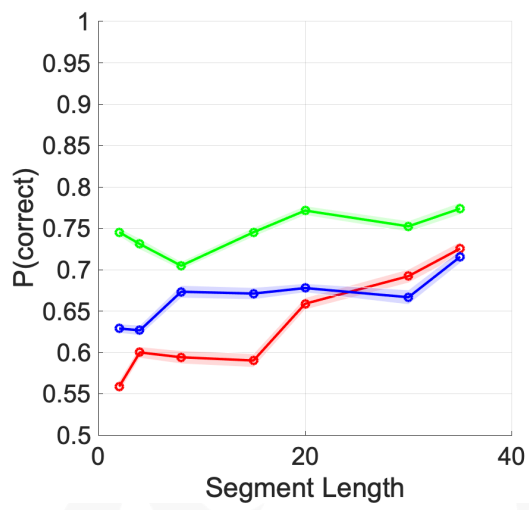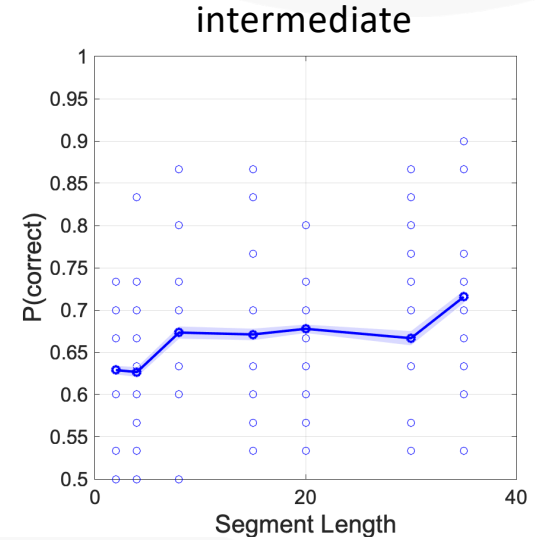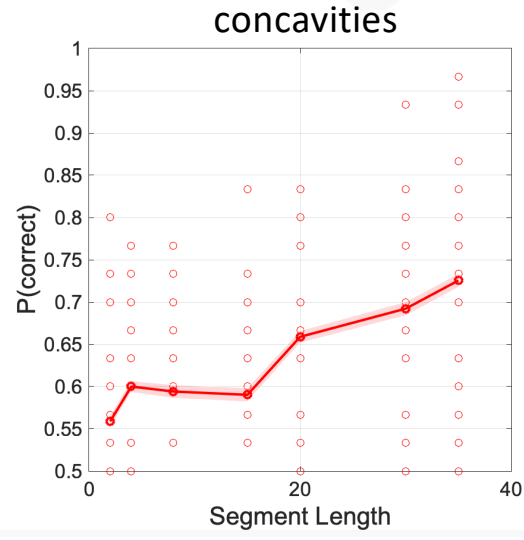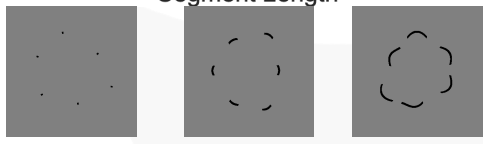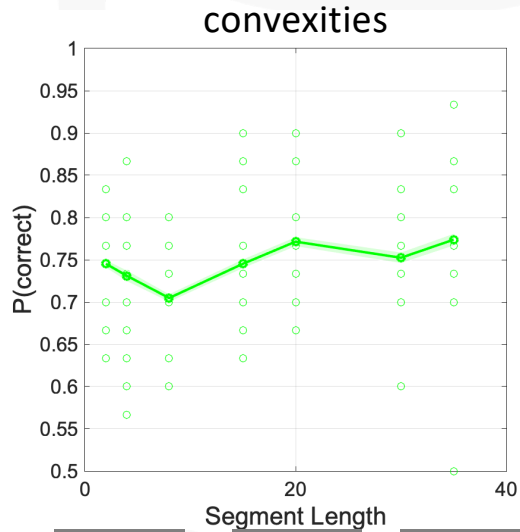
convexities
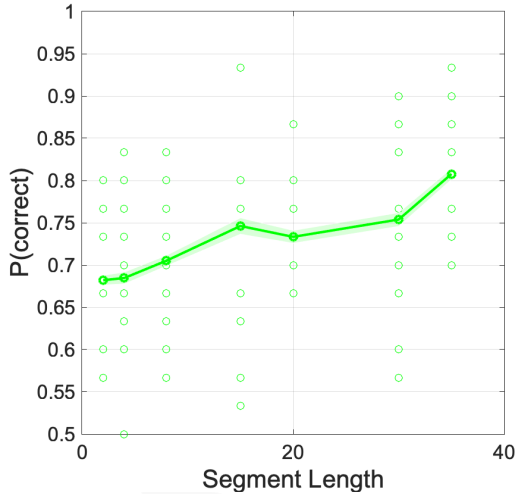
concavities
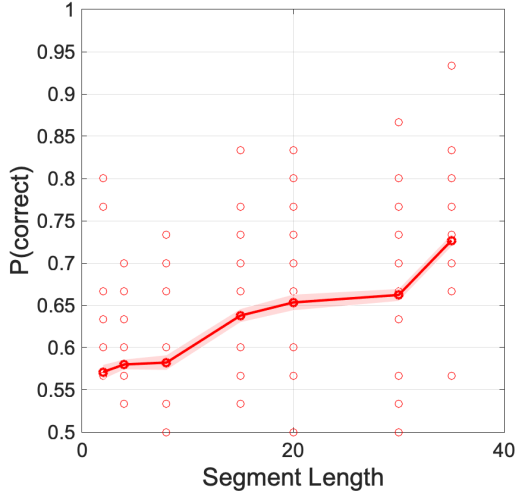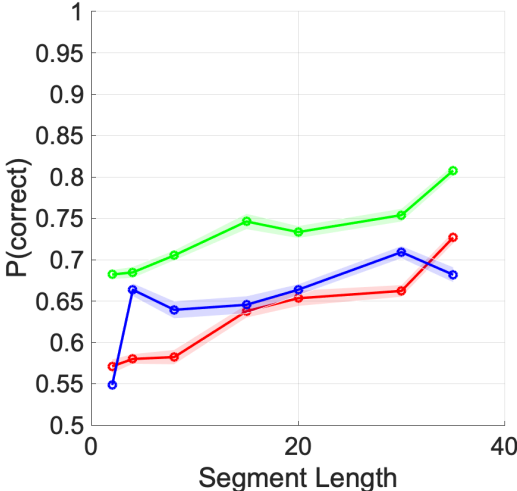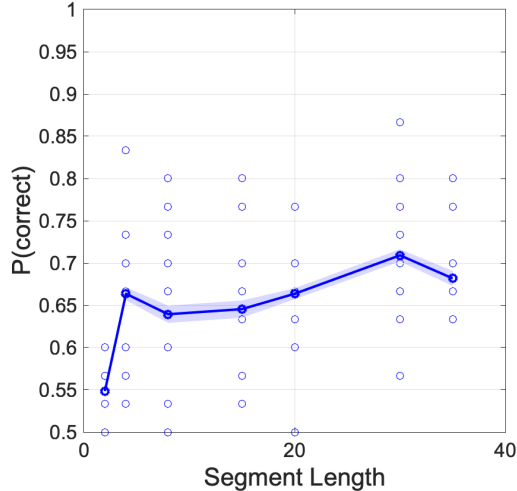
intermediate

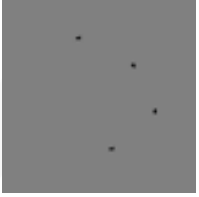# Results – 16.7% occlusion
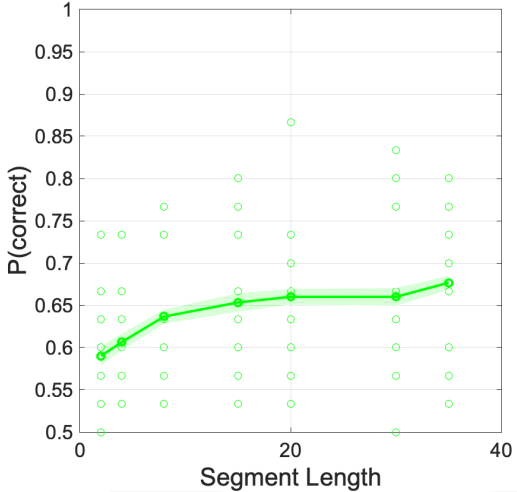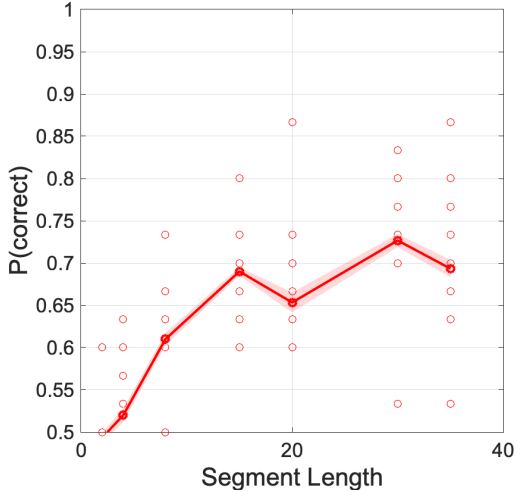
Results – 33% occlusion
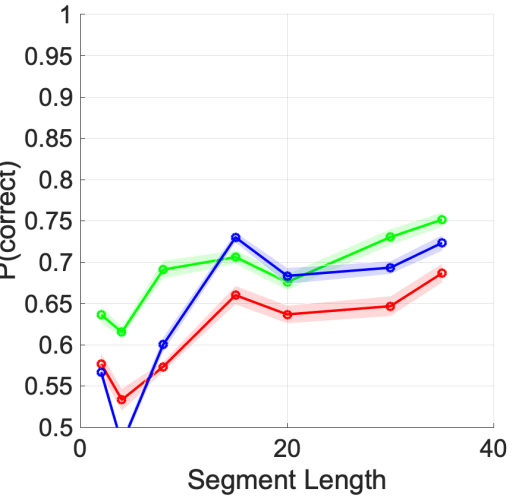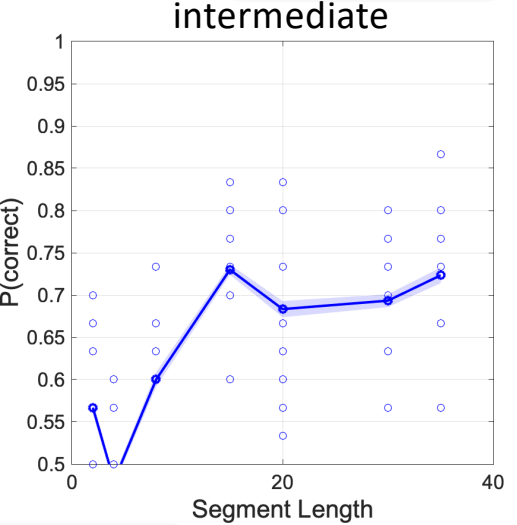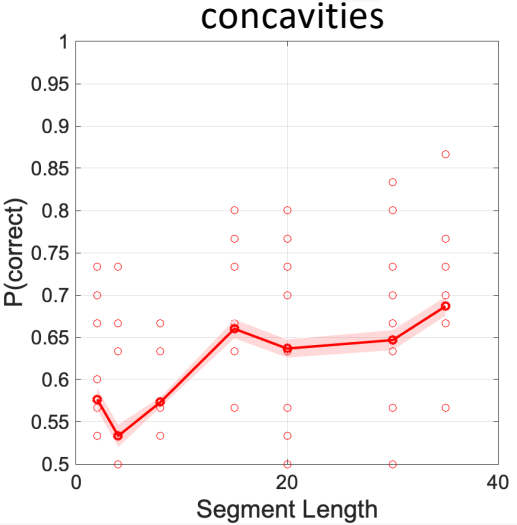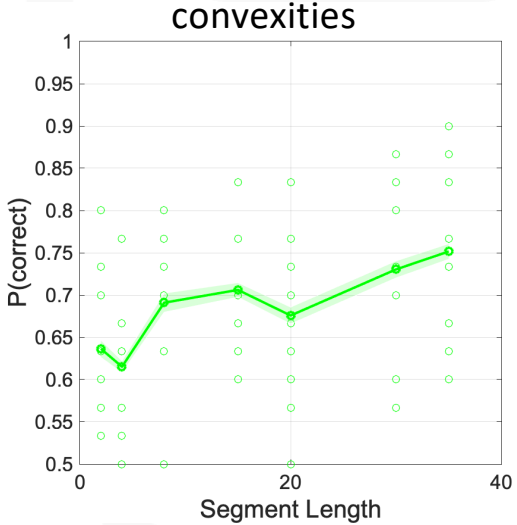
Results – 50% occlusion

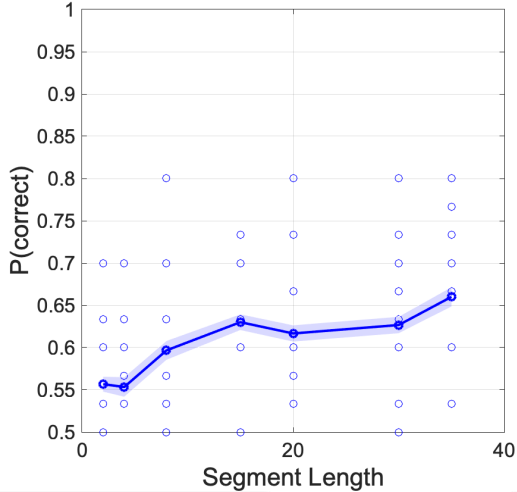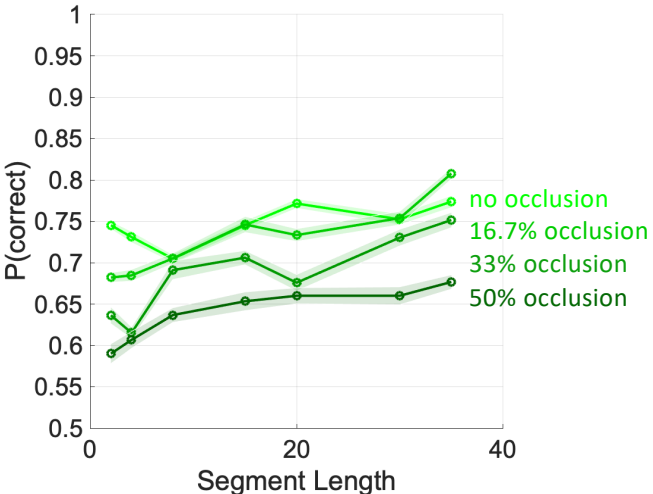# Results – combined
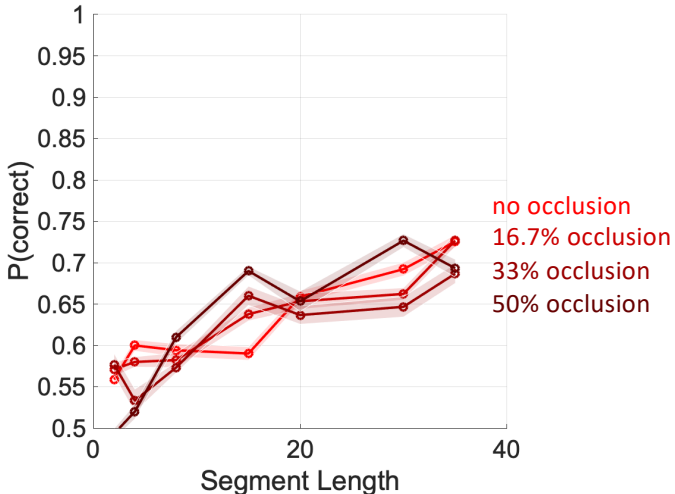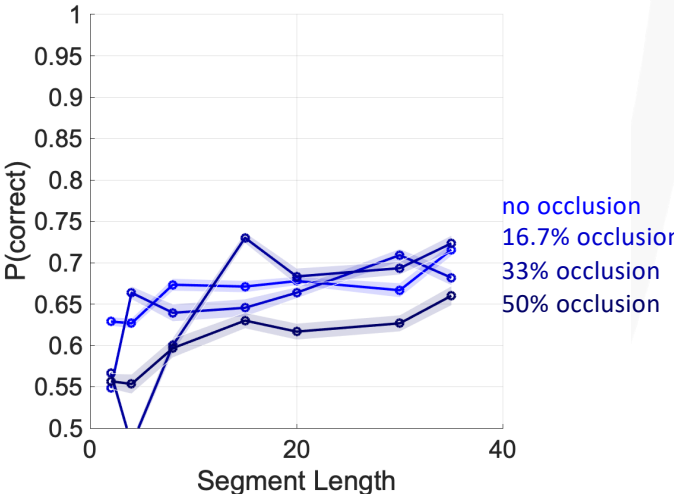
Model – Schmidtmann et al. (2015)
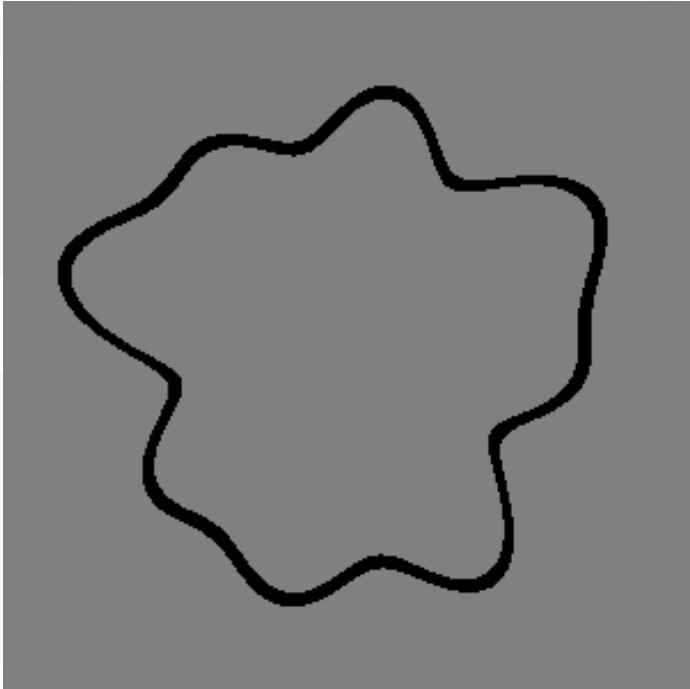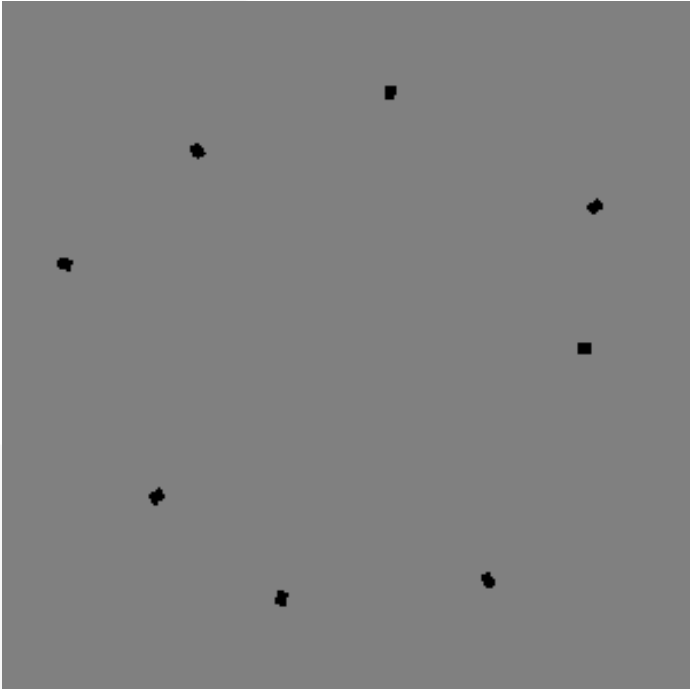
Model – Schmidtmann et al. (2015)

Model – Schmidtmann et al. (2015)

Proposed Model Idea

Occluded Reference Shape

Distractor Shape

Target Shape

Proposed Model Idea

Proposed Model Idea

Occluded Reference Shape

Distractor Shape

Target Shape
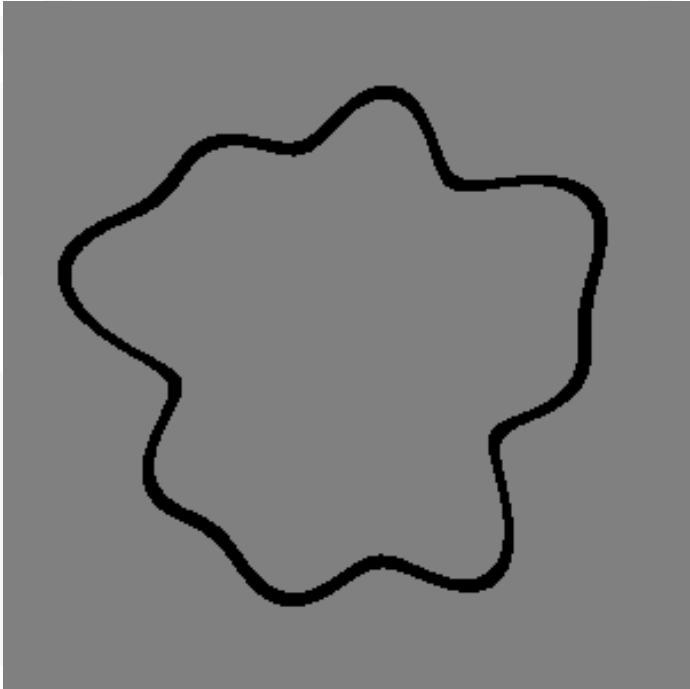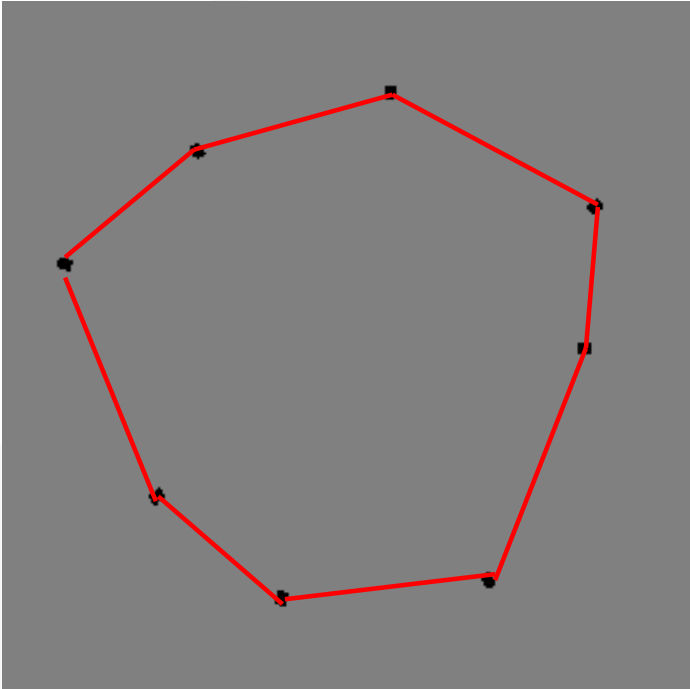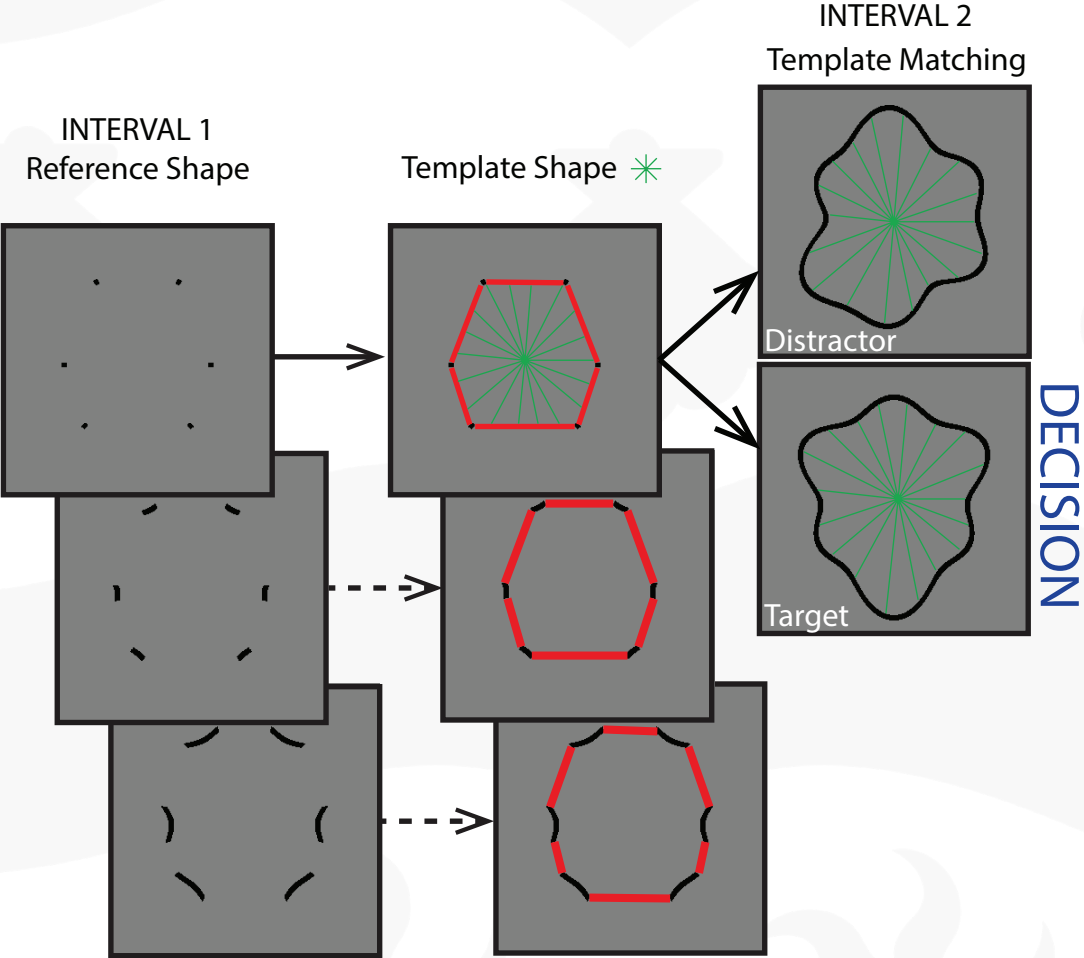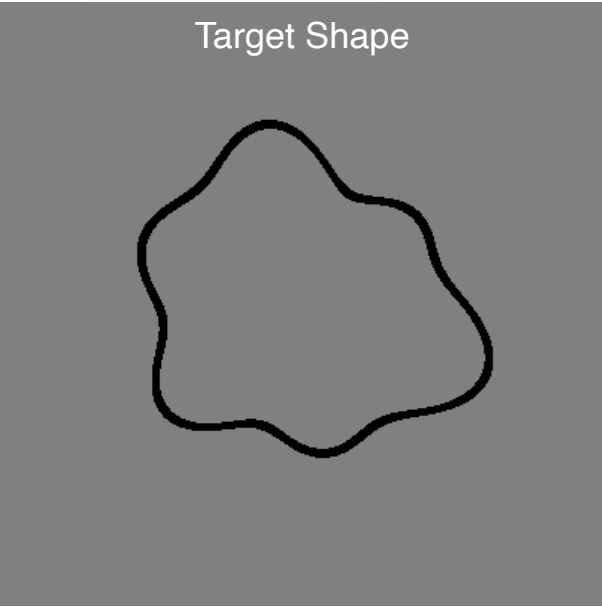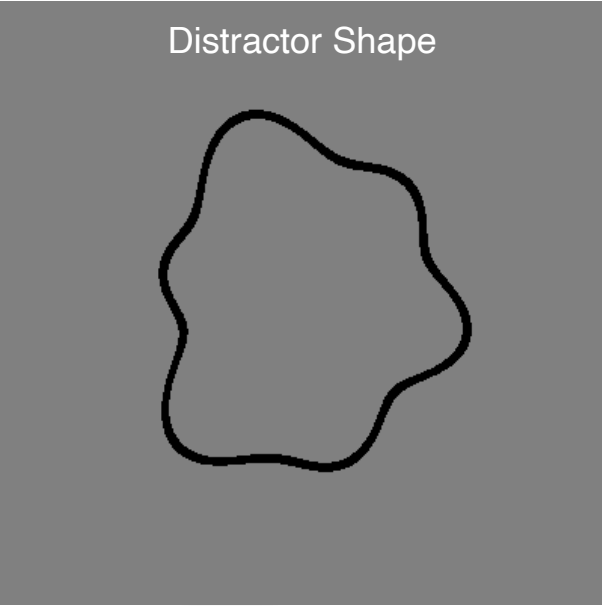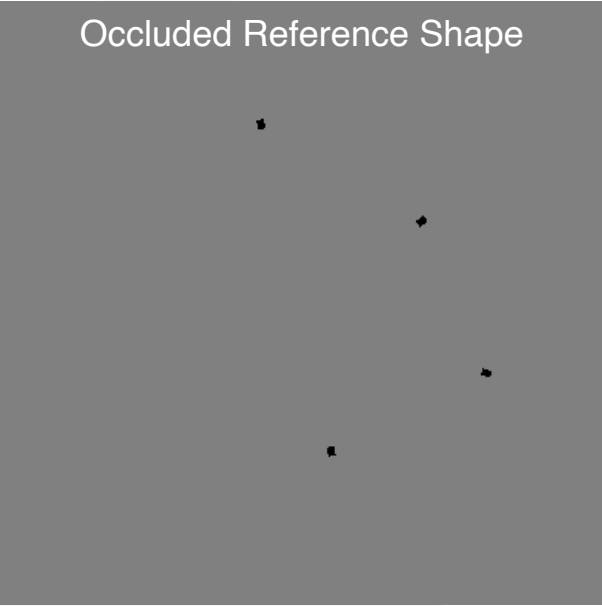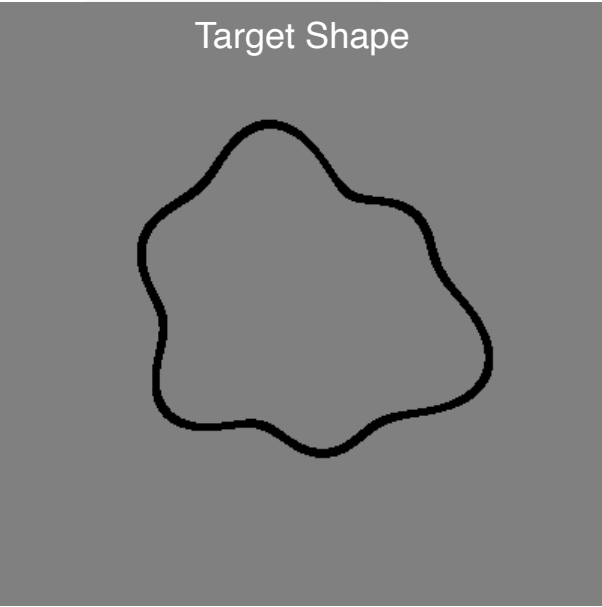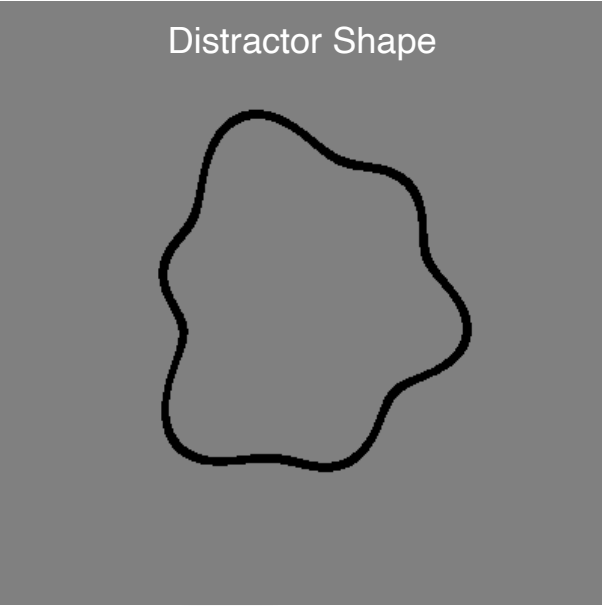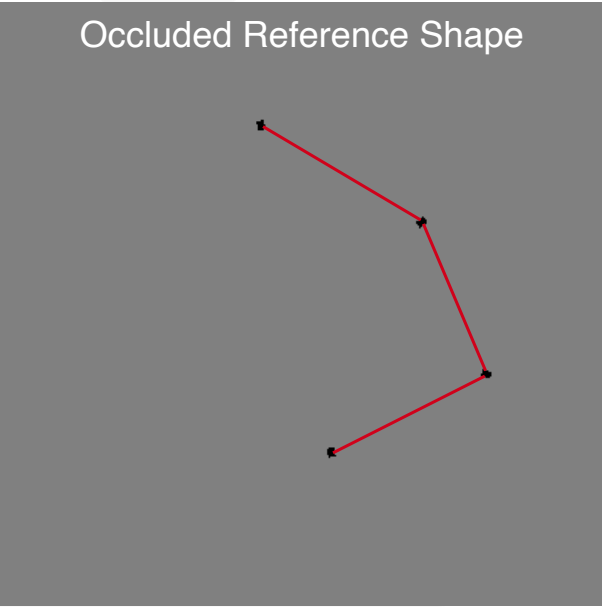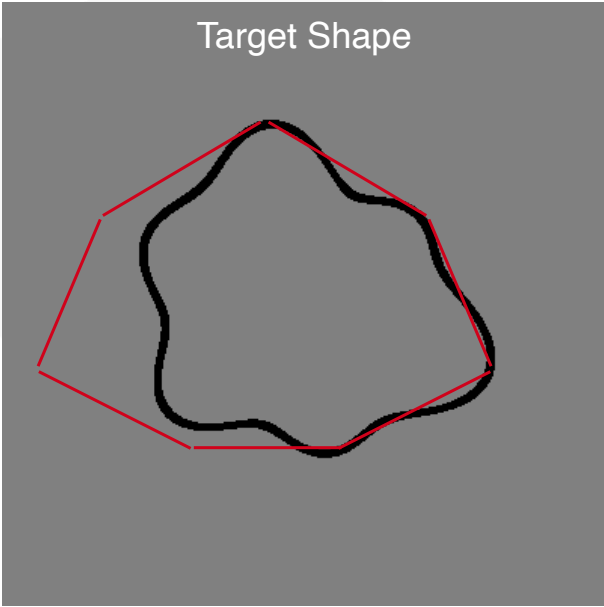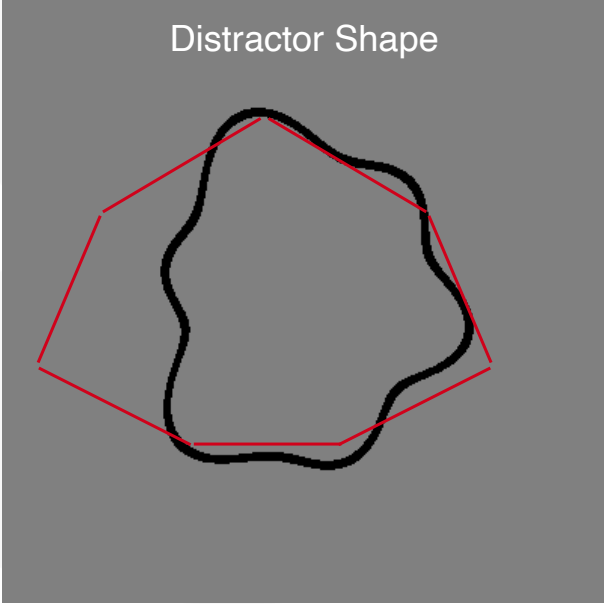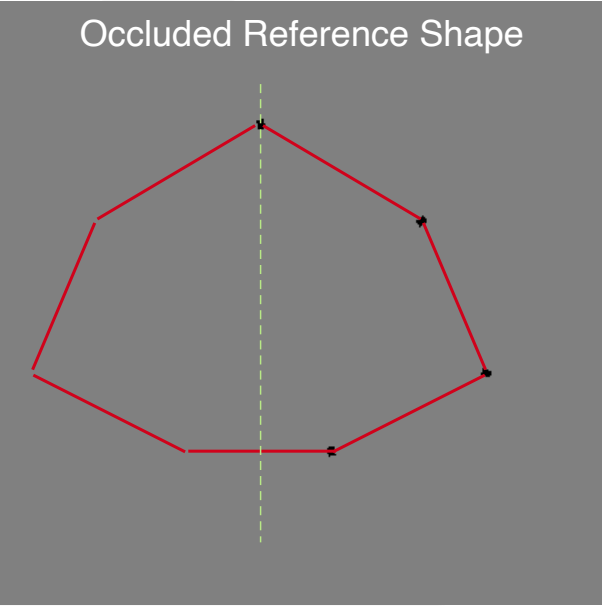
Summary

- 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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- Sohaib Naseem

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AVA Christmas Meeting 2020