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Does Precuing a Target Location Narrow the Distribution of Attention?

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Summary

The analysis presented in this poster extends earlier findings from our lab by introducing a new analysis along with an increased sample size.

Introduction

According to the selective tuning model of Tsotsos et. al (1995), an inhibitory annulus forms around the attended region via a selective pruning process.
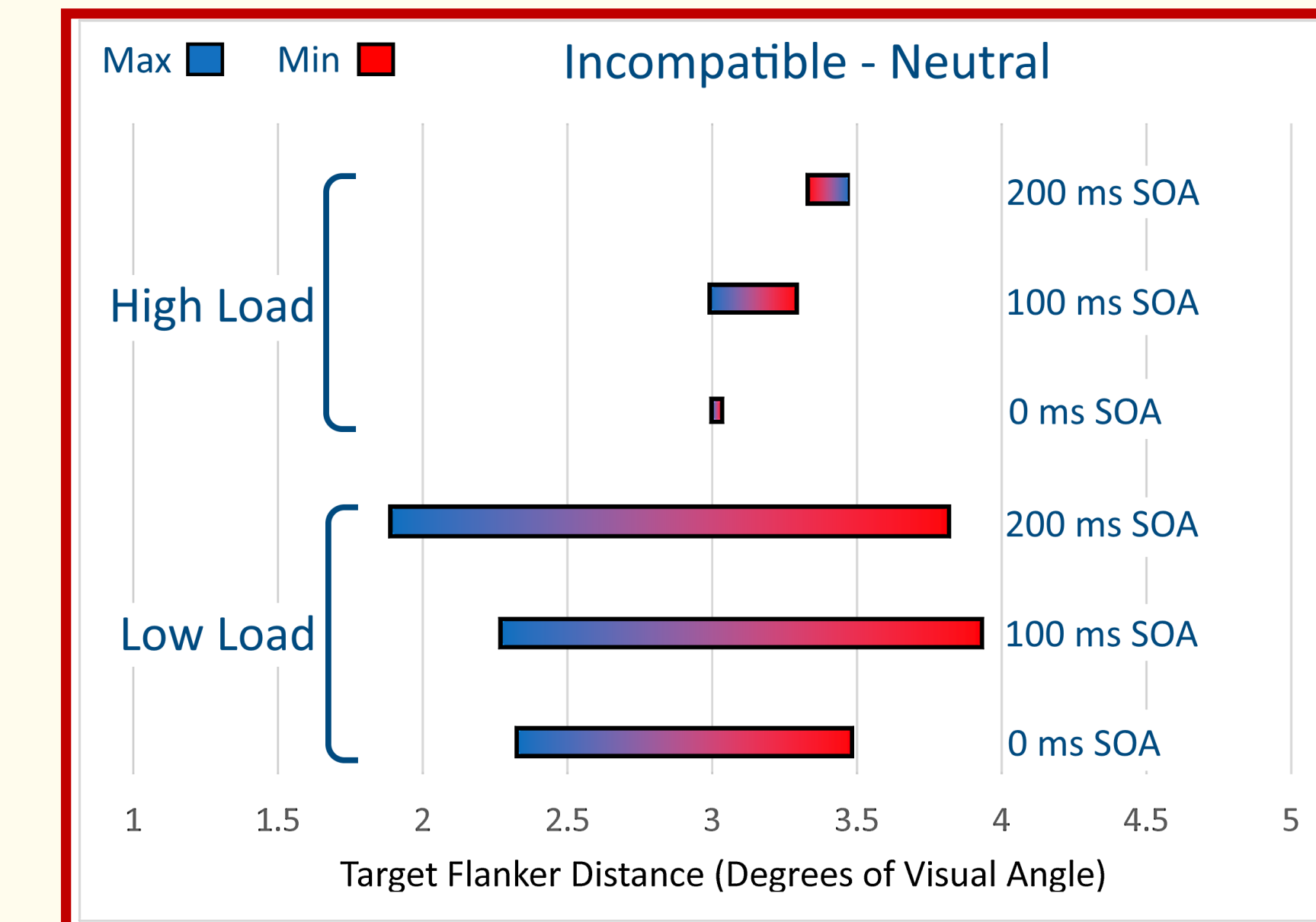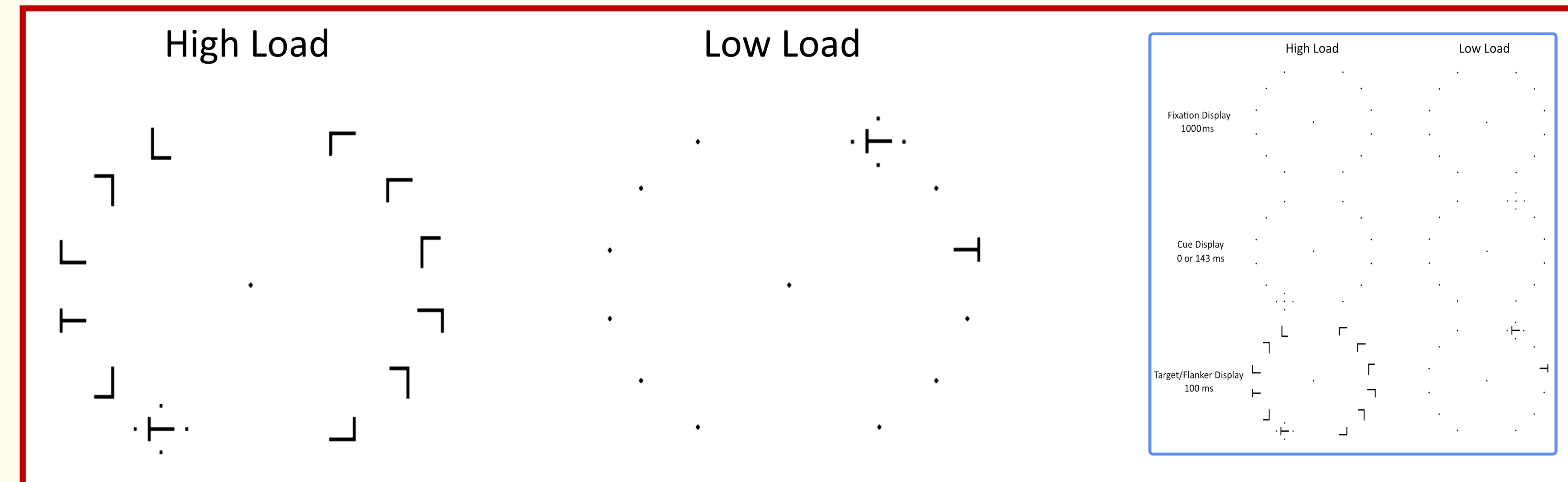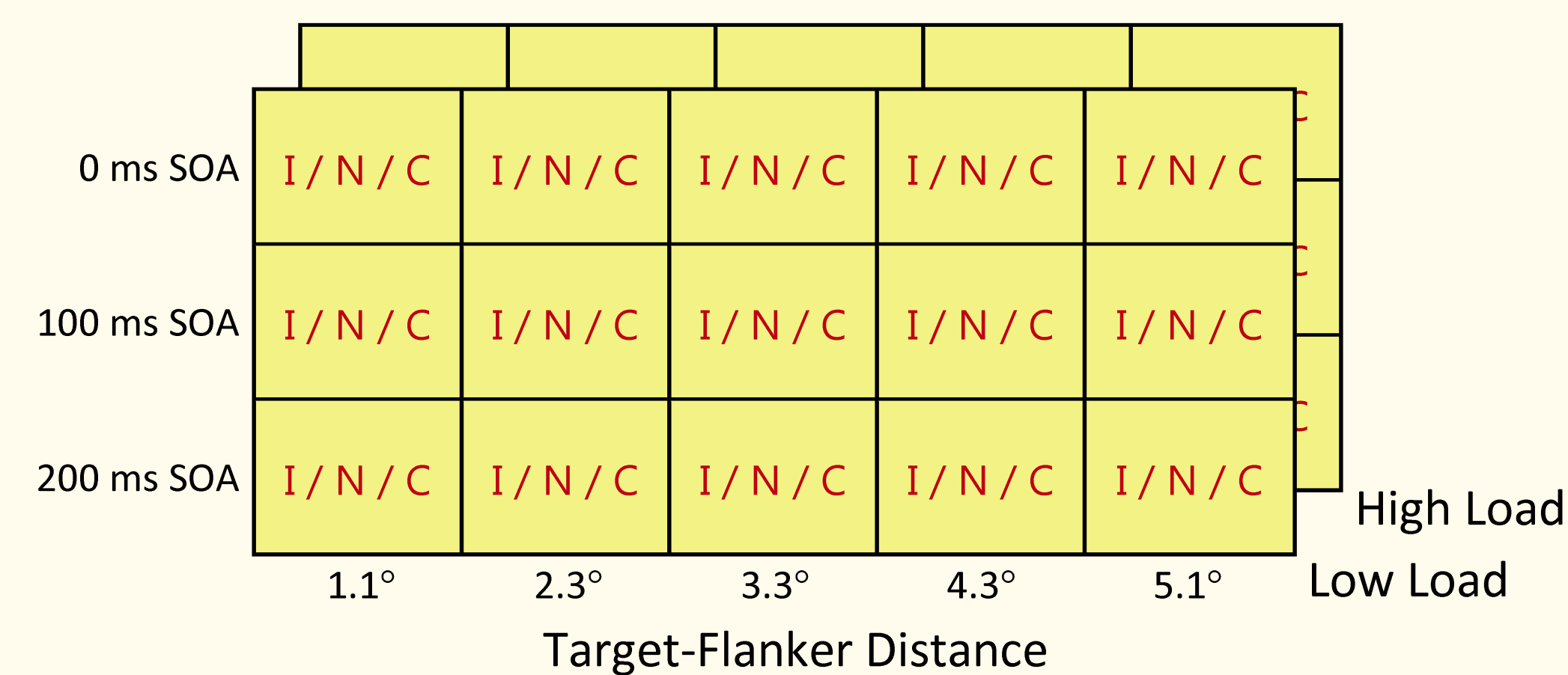
Graphic from J. K. Tsotsos
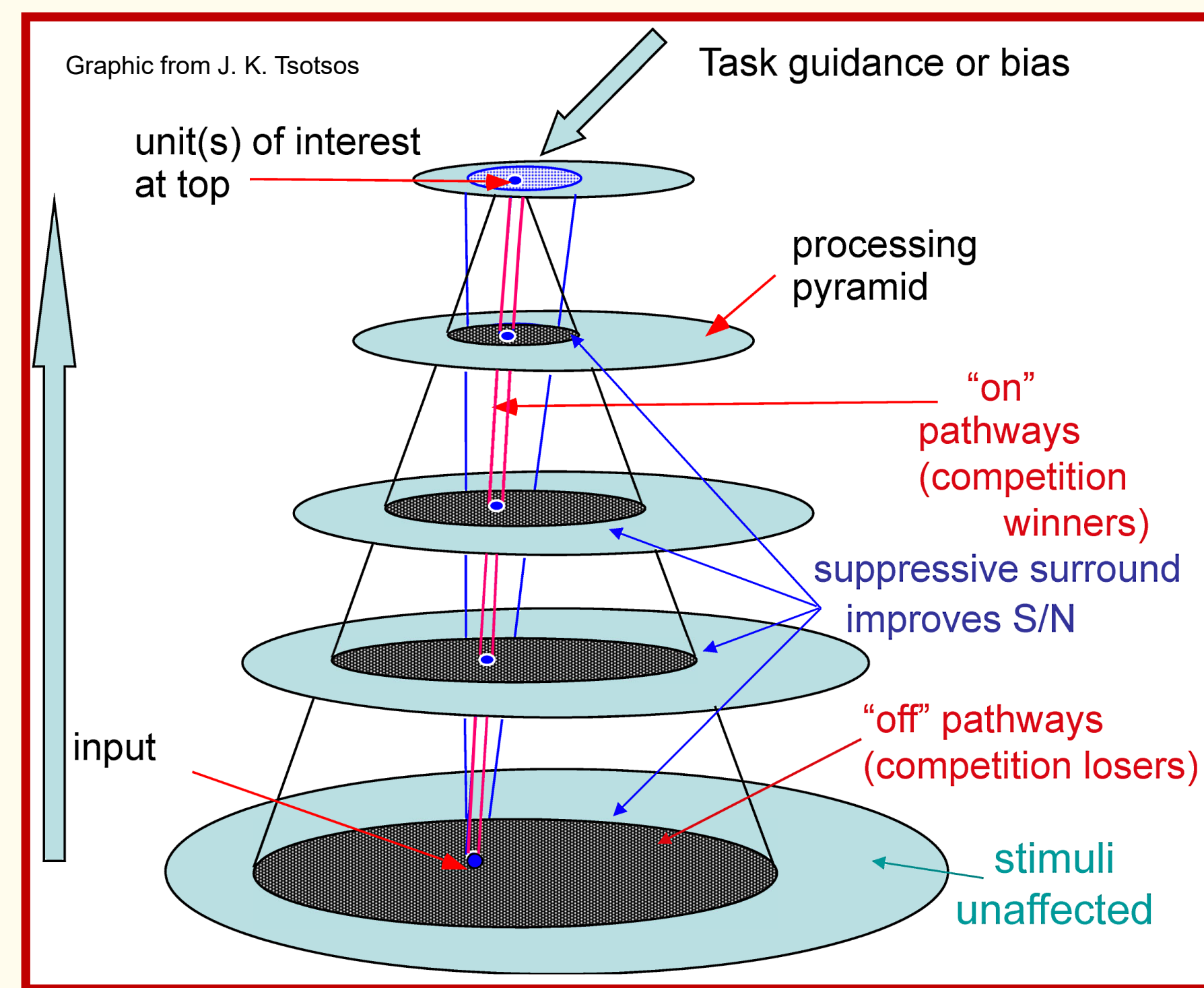
Results from our lab (Anderson et al., 2018) and from other labs (e.g., Caparos & Linnell, 2011) provide evidence of a suppressive annulus around the attended region, which varies in width and location with cue-target SOA. We found evidence of a suppressive annulus for the low perceptual load condition only.
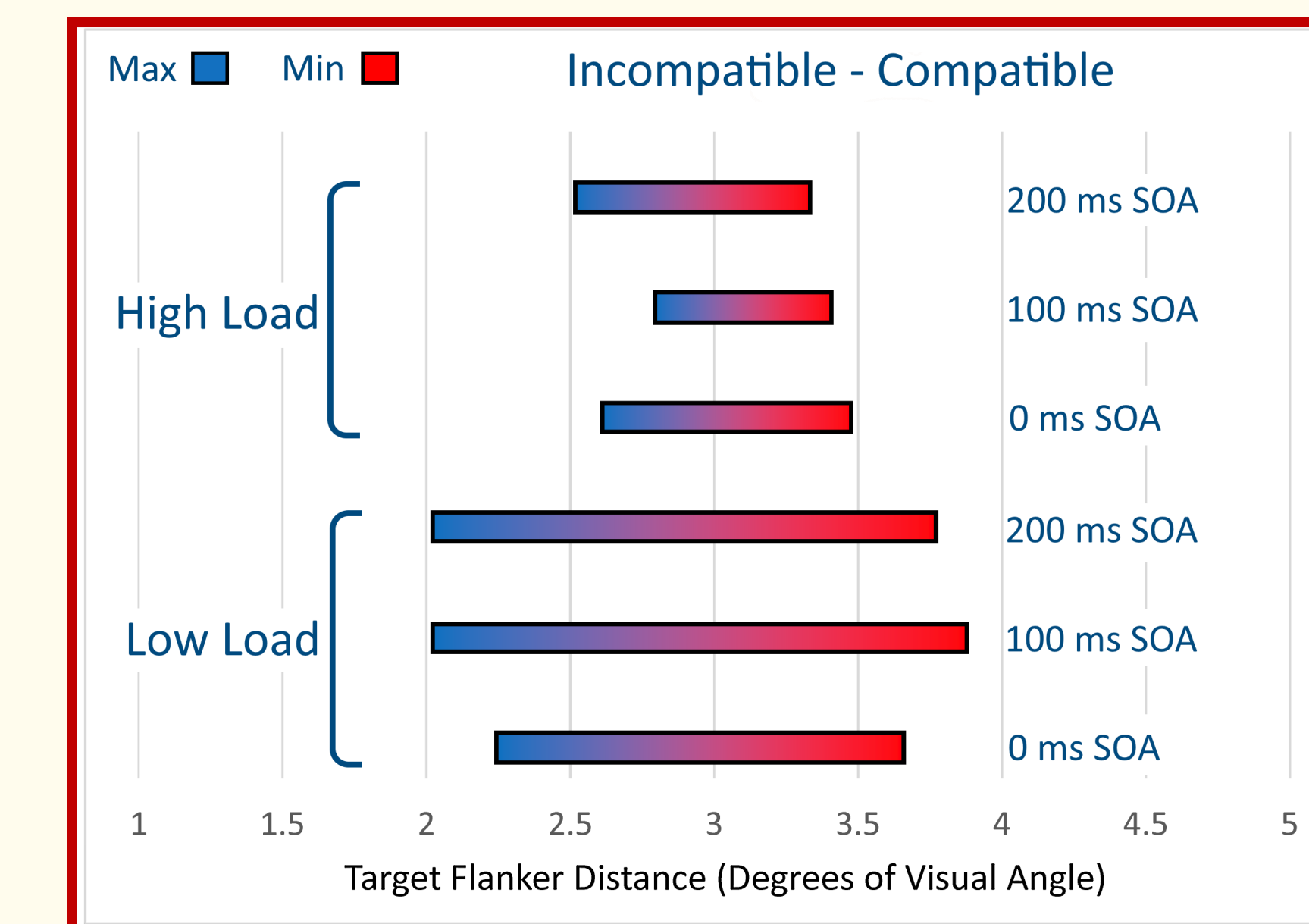
In the new analysis, polynomial fits were applied to individual flanker effect functions for each between-subjects cell of the design, and the locations of the local maximum and minimum were determined for each function. The selective tuning model would predict that the location of the maximum should move closer to the target with longer cue-target SOAs.

Method

- Participants (238 PSU students) were randomly assigned to the between-subjects conditions of the design.

	1.1°	2.3°	3.3°	4.3°	5.1°	
0 ms SOA	I / N / C	I / N / C	I / N / C	I / N / C	I / N / C	
100 ms SOA	I / N / C	I / N / C	I / N / C	I / N / C	I / N / C	High Load
200 ms SOA	I / N / C	I / N / C	I / N / C	I / N / C	I / N / C	Low Load

Target-Flanker Distance

High Load   Low Load

Fixation Display 1000ms

Cue Display 0 or 143 ms

Target/Flanker Display 100 ms

- Mean flanker effects were computed for all participants and averaged across participants.

- Polynomial regression was used to establish the best-fitting function for individual participants, by condition (example at right).

Cubic Fit

$y = -12.602x^3 + 130.12x^2 - 405.38x + 415.77$
$R^2 = 0.9997$

Quadratic Fit

$y = -11.67x^2 + 68.175x - 33.608$
$R^2 = 0.8686$

Results

- Mean flanker effects (incompatible - compatible, and incompatible - neutral), were submitted to planned, repeated-measures ANOVAs for each combination of load and cue-target SOA.

- Significant linear and quadratic trends in low-load, 0 ms, and 100 ms SOA conditions

- Significant linear, quadratic and cubic trends in the low-load, 200 ms SOA condition.

- No significant trends in the high-load conditions, except for a linear trend with the compatible baseline at 0 ms SOA.

- Average locations of local maxima were significantly closer to the target location in the low load conditions for both the compatible and neutral baselines.

- Visible trend for maxima to move closer to target-location as predicted by the selective tuning model, but the outcome was statistically non-significant.

Conclusions

- No evidence of a Mexican-hat-like distribution in any of the high load conditions.

- The findings in the low load conditions are largely compatible with past research, and give evidence of a suppressive annulus surrounding the focus of attention.

- Width and location of the suppressive region in the low load conditions varied with precue SOA.

Selected References

Anderson, R., Loethen, E., Lueck, S., Crager, M., Roecker, L., Morris, S., Swadley, A., Wright, J., Poulsen, K., Ashcraft, R., & Warner, B. (2018, April 12). Evidence of a suppressive annulus around the focus of attention. Poster presented at the annual meeting of the Midwestern Psychological Association, Chicago, IL.

Caparos, S., & Linnell, K. J. (2011). Perceptual and cognitive load interact to control the spatial focus of attention. *Journal of Experimental Psychology: Human Perception and Performance*, 37, 1643–1648. doi: 10.1037/a0024669

Tsotsos, J. K., Culhane, S. W., Wai, Y. L., Davis, N., & Nuflo, F. (1995). Modeling visual attention via selective tuning. *Artificial Intelligence*, 78, 507–547. doi: 10.1016/0004-3702(95)00025-9

Incompatible - Neutral

Max ■   Min ■

High Load — 200 ms SOA / 100 ms SOA / 0 ms SOA
Low Load — 200 ms SOA / 100 ms SOA / 0 ms SOA
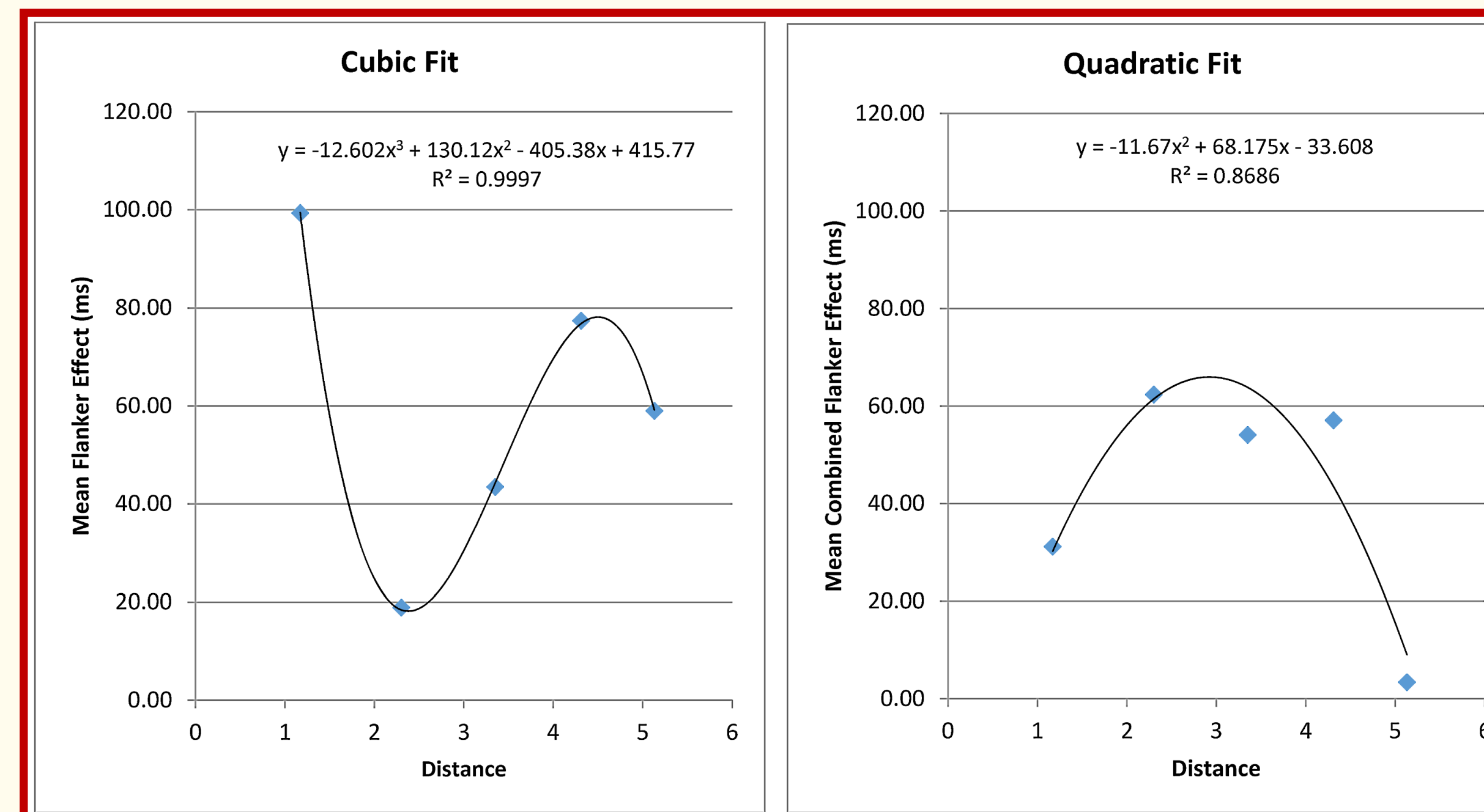
Target Flanker Distance (Degrees of Visual Angle)

Graph at left shows the ranges for locations of local maxima versus minima (in degrees of visual angle) by cue-target SOA and perceptual load, for the neutral baseline.

Incompatible - Compatible

Max ■   Min ■

High Load — 200 ms SOA / 100 ms SOA / 0 ms SOA
Low Load — 200 ms SOA / 100 ms SOA / 0 ms SOA

Target Flanker Distance (Degrees of Visual Angle)

Graph at left shows the ranges for locations of local maxima versus minima (in degrees of visual angle) by cue target SOA and perceptual load, for the compatible baseline.

Graphs below plot mean flanker effects (in milliseconds) across target-flanker distance for both the neutral and the compatible baselines

Low Load (Incompatible - Neutral)

Target-Flanker Distance (Degrees of Visual Angle)

0 ms — 100 ms — 200 ms

High Load (Incompatible - Neutral)

Target-Flanker Distance (Degrees of Visual Angle)

0 ms — 100 ms — 200 ms

Low Load (Incompatible - Compatible)

Target-Flanker Distance (Degrees of Visual Angle)

0 ms — 100 ms — 200 ms

High Load (Incompatible - Compatible)

Target-Flanker Distance (Degrees of Visual Angle)

0 ms — 100 ms — 200 ms