# Spatial summation within static and dynamic Glass patterns


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## Introduction

- The visual system combines information from neurons in early cortical areas tuned to local stimulus features, such as orientation and spatial frequency
- Previous studies have reported linear summation for detection thresholds and proposed specialized concentric (circular) orientation detectors for static[1-6] and dynamic[7] patterns
- These previous summation studies typically applied probability summation models based on High Threshold Theory (HTT, Quick Pooling Model)
- The model assumes a high threshold and therefore negligible false-positive responses. According to this model, thresholds fall with a power-law slope of -1/exponent of the psychometric function.[8-9]
- Under HTT, linear summation predicts that the decrease in threshold with increasing signal area follows a power-law function (in log-log coordinates) with a slope of –1.0 (matched attention window, spatial certainty) or –0.5 (fixed attention window, spatial uncertainty).[10-11] However, there is considerable evidence that Signal Detection Theory (SDT) is a more accurate model of decision making
- Schmidtmann et al. (2015) measured lower slopes for Glass patterns (GPs), and concluded that probability summation modelled under SDT summation model framework[12], and ***not*** linear summation mediates the detection of orientation-defined patterns

## Aims

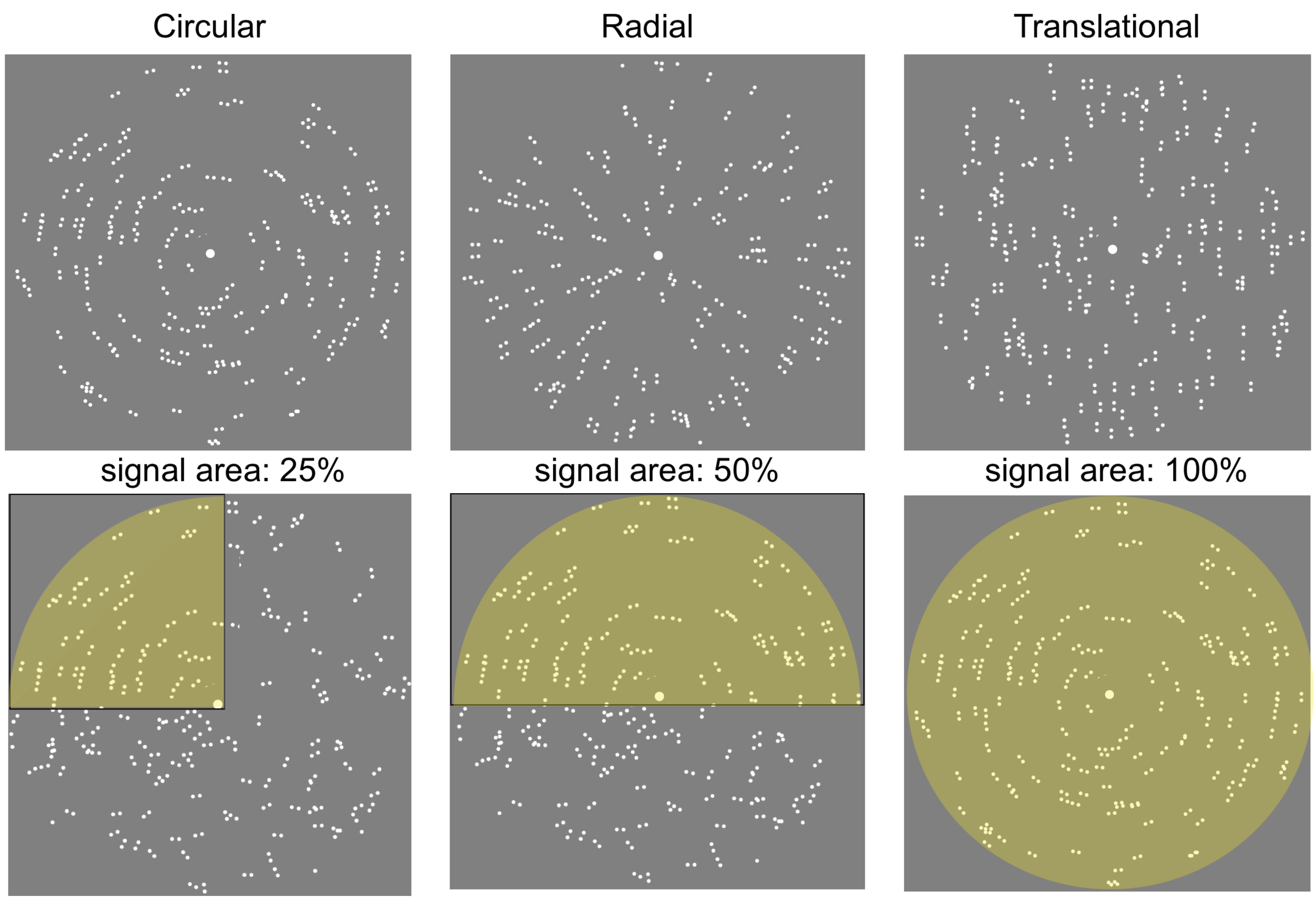
- To investigate the signal integration for static and dynamic GP for different texture types (circular, radial, and translational)
- To analyse the data with respect to HTT and SDT summation models

## Methods

**Subjects:** n = 4, normal or corrected to normal VA

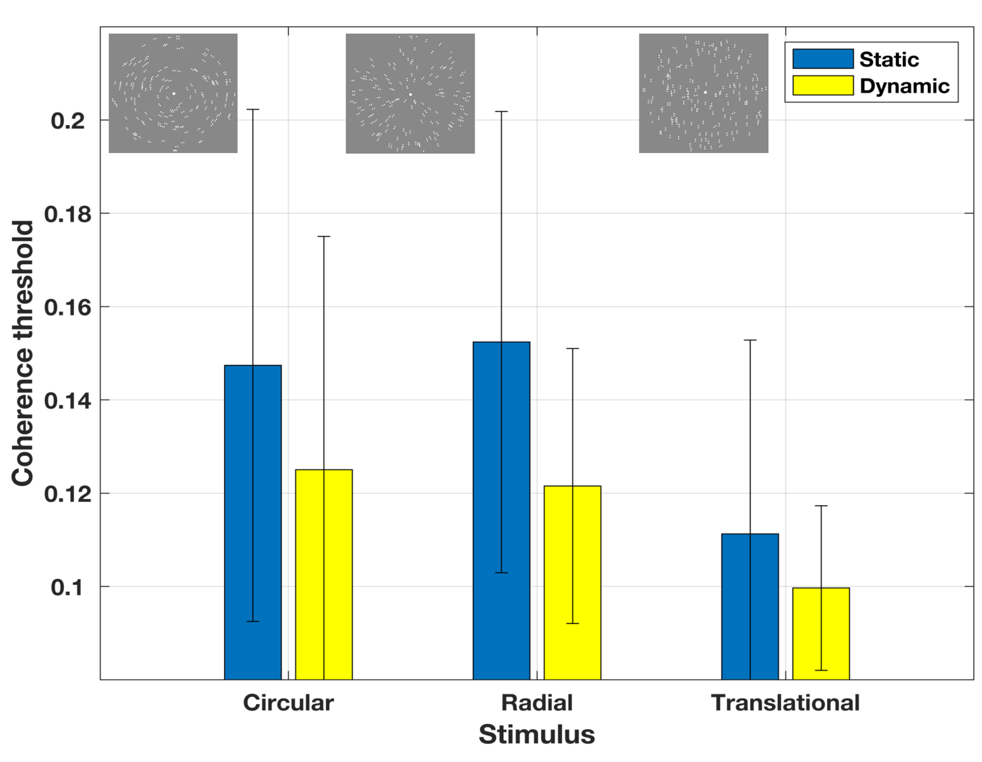
**Stimuli**: Static and dynamic (circular, radial, and translational) GP

- *Static GP:* 200 dipoles (400 dots)
- *Dynamic GP:* 9 frames of static GP displayed over 0.5 secs
- Pie-wedge shaped signal area ranging from 25%, 50% and 100%
- Matched attention window (spatial certainty) and fixed attention window (spatial uncertainty)[10-11]
- 6 signal levels x 3 stimuli area x 20 trials = 360 trials for each stimuli

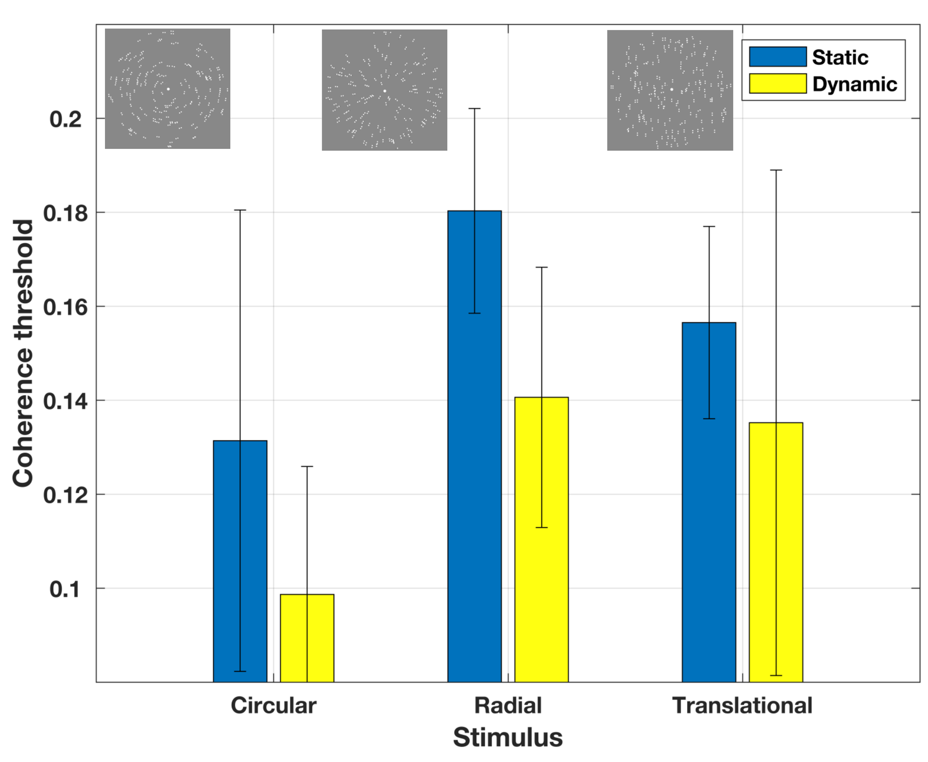



## Results

- Thresholds were lower overall for dynamic compared to static GPs for both matched (0.15±0.06 vs. 0.20±0.08) and fixed (0.19±0.07 vs. 0.23±0.07) attention window
- For the full pattern (signal area = 100%) there was no difference in coherence thresholds among the pattern types for both dynamic and static GPs
- The thresholds for all Glass patterns reduced as a function of increasing signal area
- However, the slopes were significantly lower than predicted by the linear summation model; matched attention window: max = -0.35 for circular, dynamic GP & -0.62 for radial static GP; fixed attention window: max = -0.68 for circular, dynamic GP & -0.56 for translational static GP

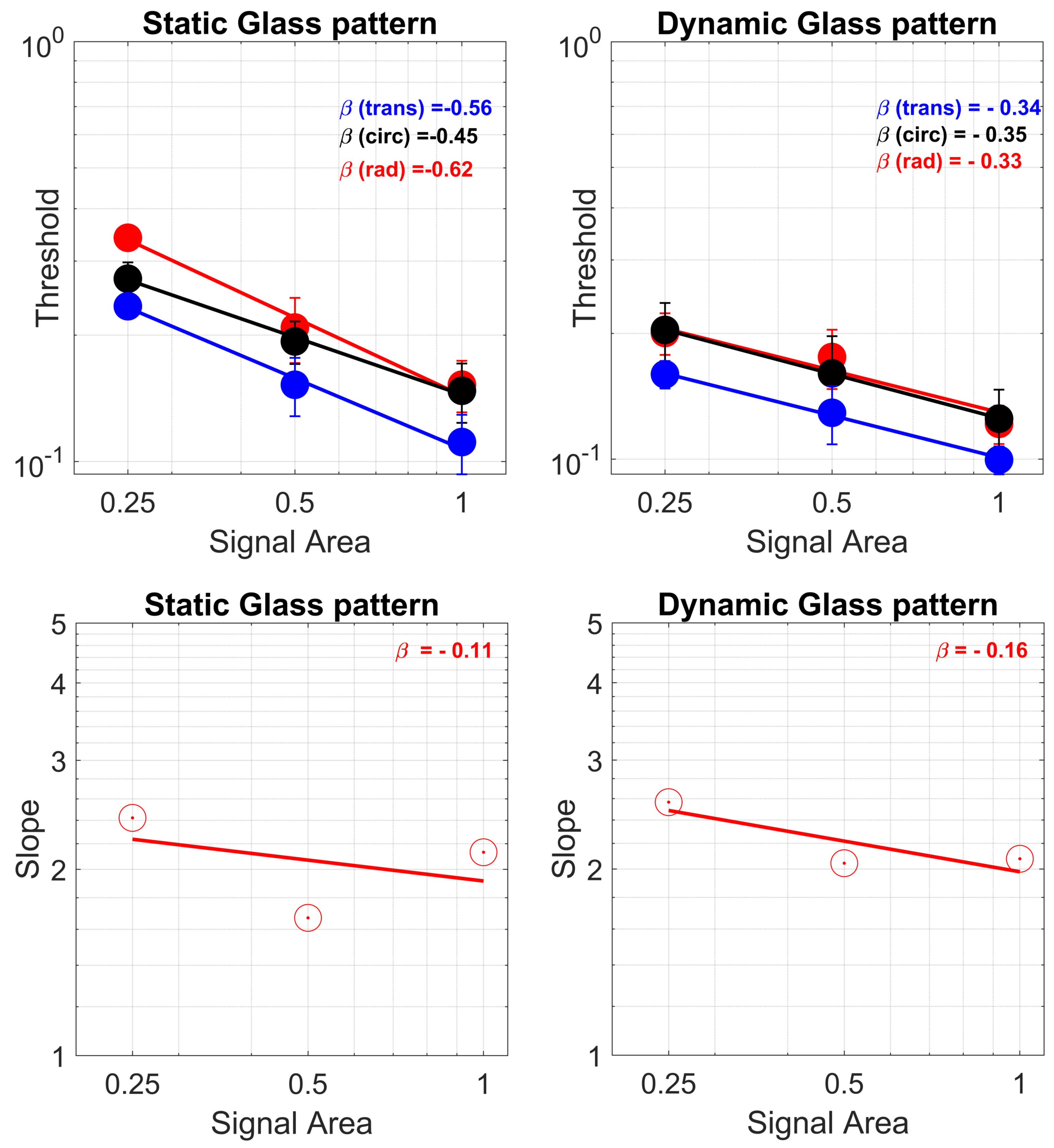



Matched attention window

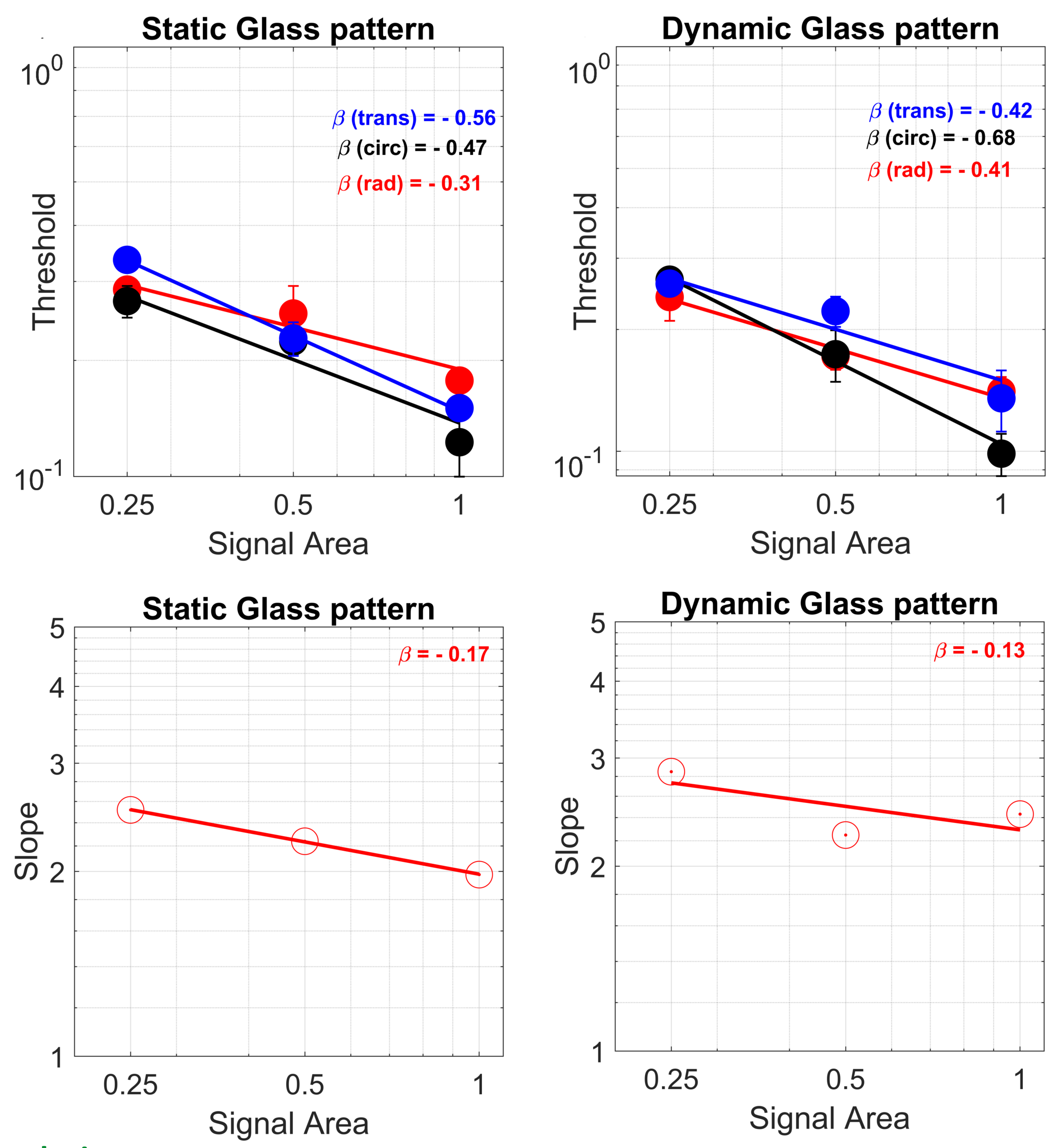



Fixed attention window

## Matched attention window (spatial certainty)




## Fixed attention window (spatial uncertainty)




## Conclusion

- Psychometric function slopes decrease with increasing certainty -> **SDT PS**
- Contrary to previous studies, **we do not find summation strength close to linear summation** (-1.0). for both, static (-0.49±0.11) and dynamic (-0.42±0.13) GPs.
- We do **not find** evidence for special detectors for circular GPs; **detection sensitivity is independent of texture type**.
- Both HTT and SDT summation models predict that **probability summation and not linear summation** mediates the detection of static and dynamic GPs.
- The results support a 3-stage summation model for static and dynamic GPs with final pooling of local inputs via probability summation.[10]

## References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