2019-12-16

Summation Within and Across Shapes in Central and Peripheral Vision

Schmidtmann, Gunnar

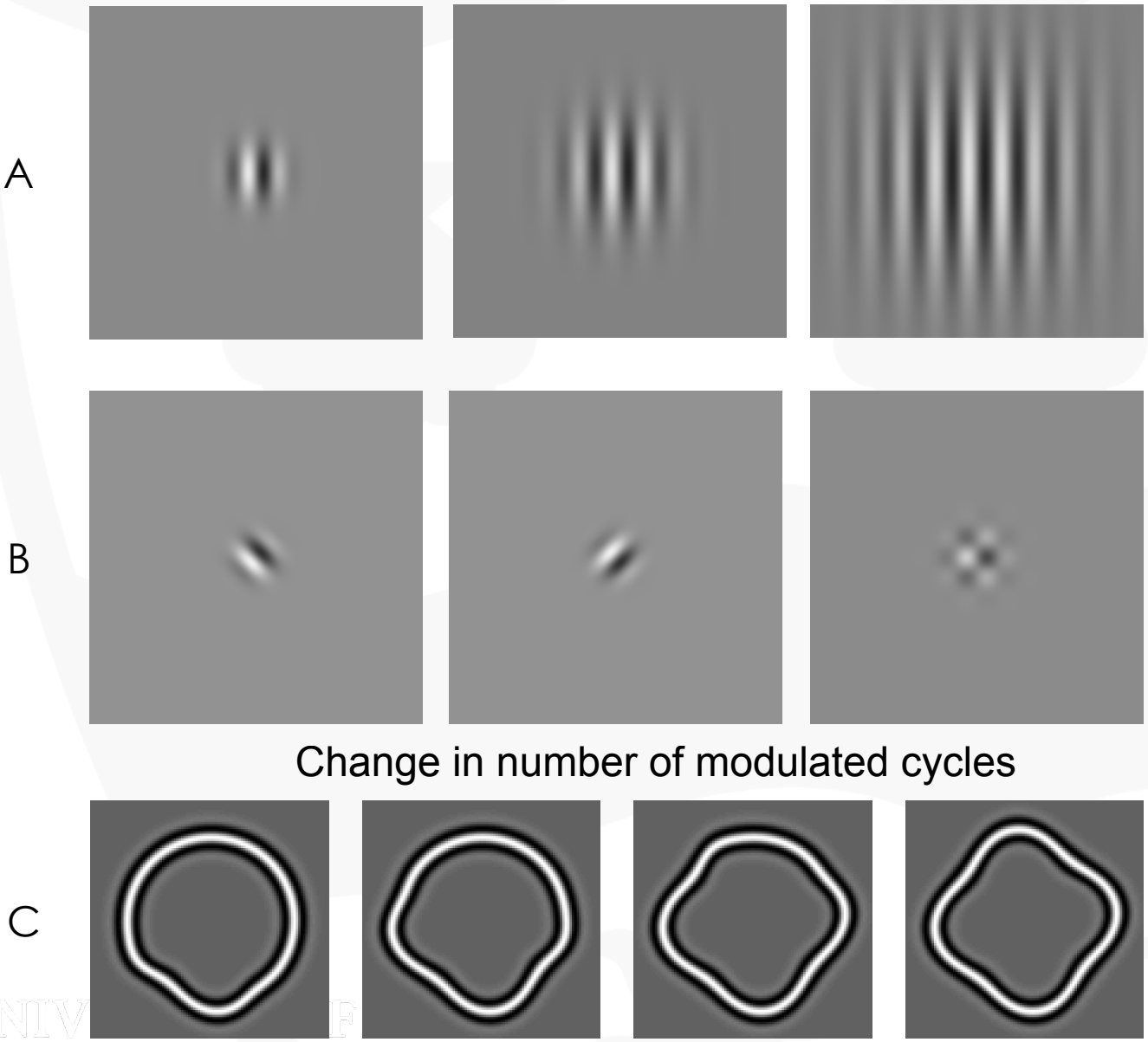
10.1177/0301006620921389
PERCEPTION

Summation within and acro
central and periphera

Gunnar Schmidtmann & Maria Z

UNIVERSITY OF
PLYMOUTH

Summation experiments



Stimuli

Frequency

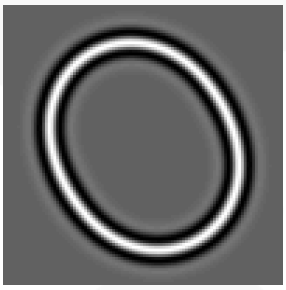
Amplitude

$$r(\theta) = r_{mean}\left(1 + A(\omega\theta + \varphi)\right)$$

Wilkins
of radi

Stimuli

Change in frequency



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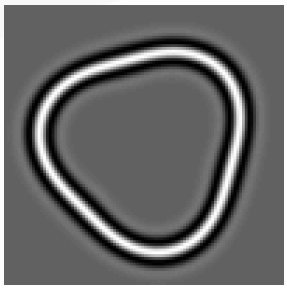

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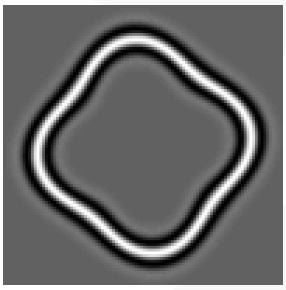
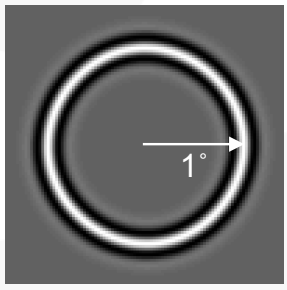
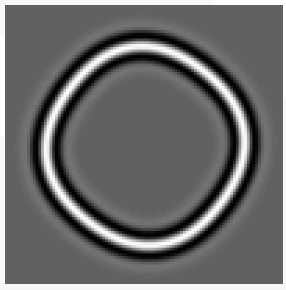


4

5

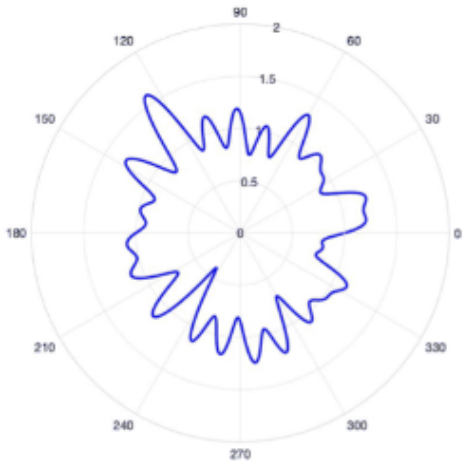
Change in amplitude

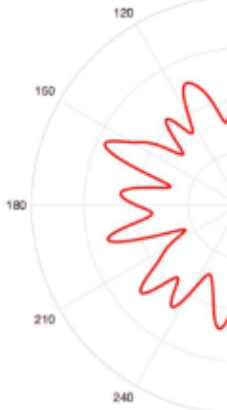




RF compounds – shape channels

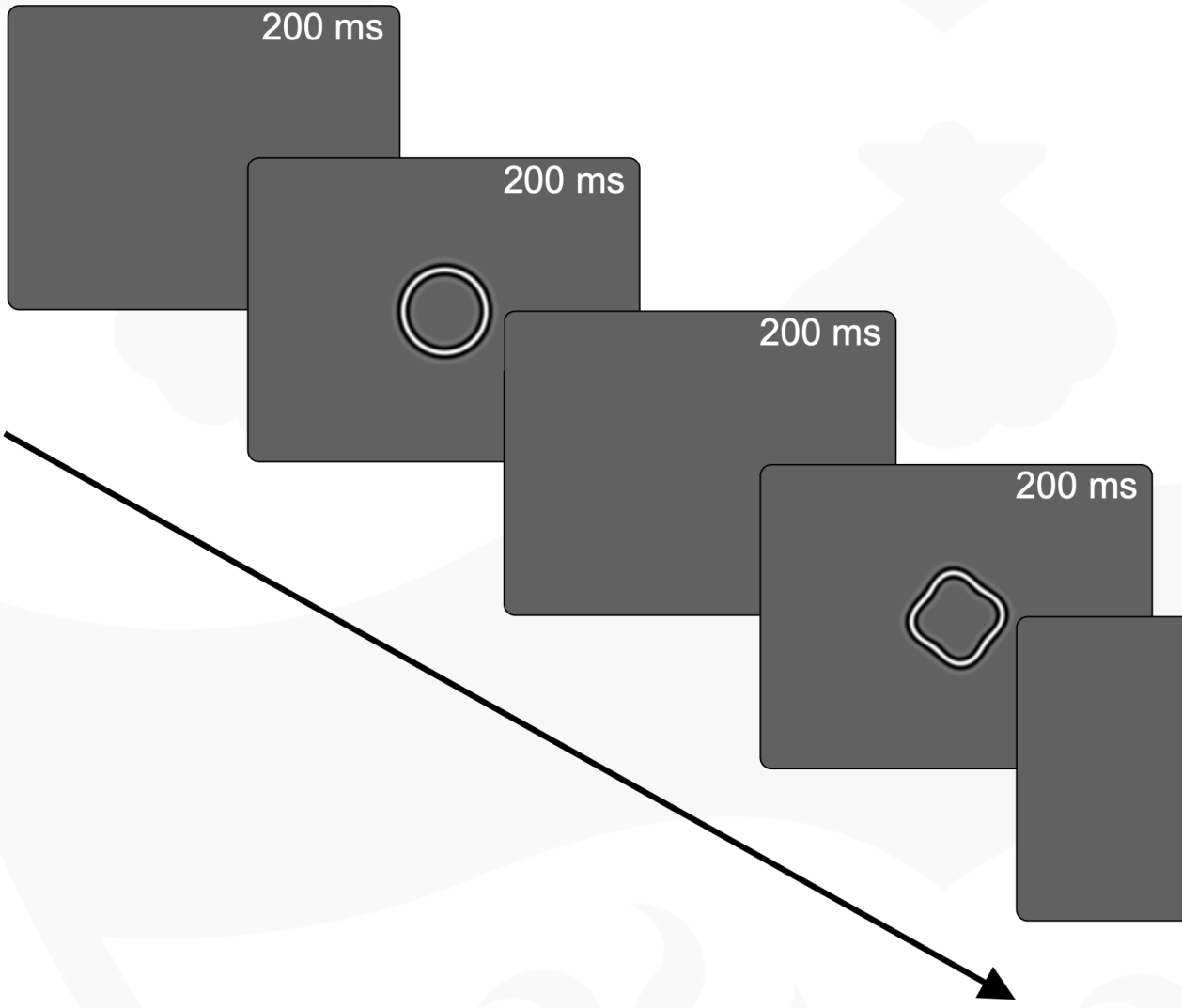
$$r(\theta) = r_{mean}\left(1 + \sum_{n}^{m} A_n sin(\omega_n \theta + \varphi_n)\right)$$



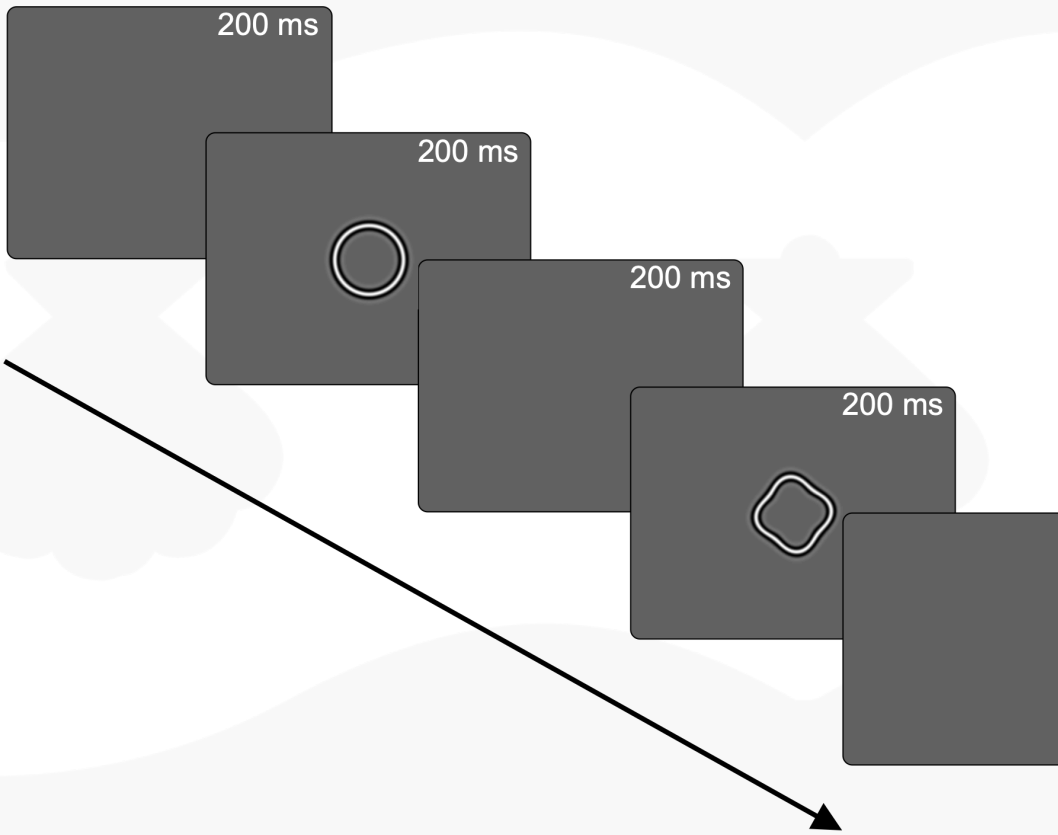


- Schmidtmann, G., & Fruen perceptually distinct subs
- Schmidtmann, G., Kingdo frequency patterns. *Visio*

Paradigm

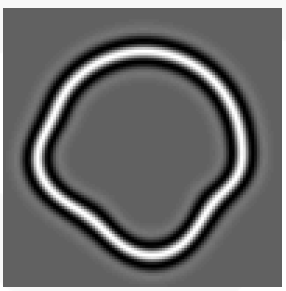


Paradigm



Change in number of modulated c

1



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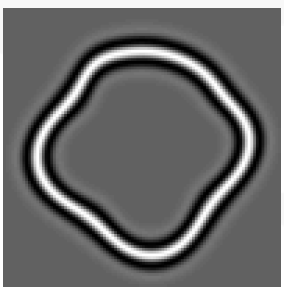
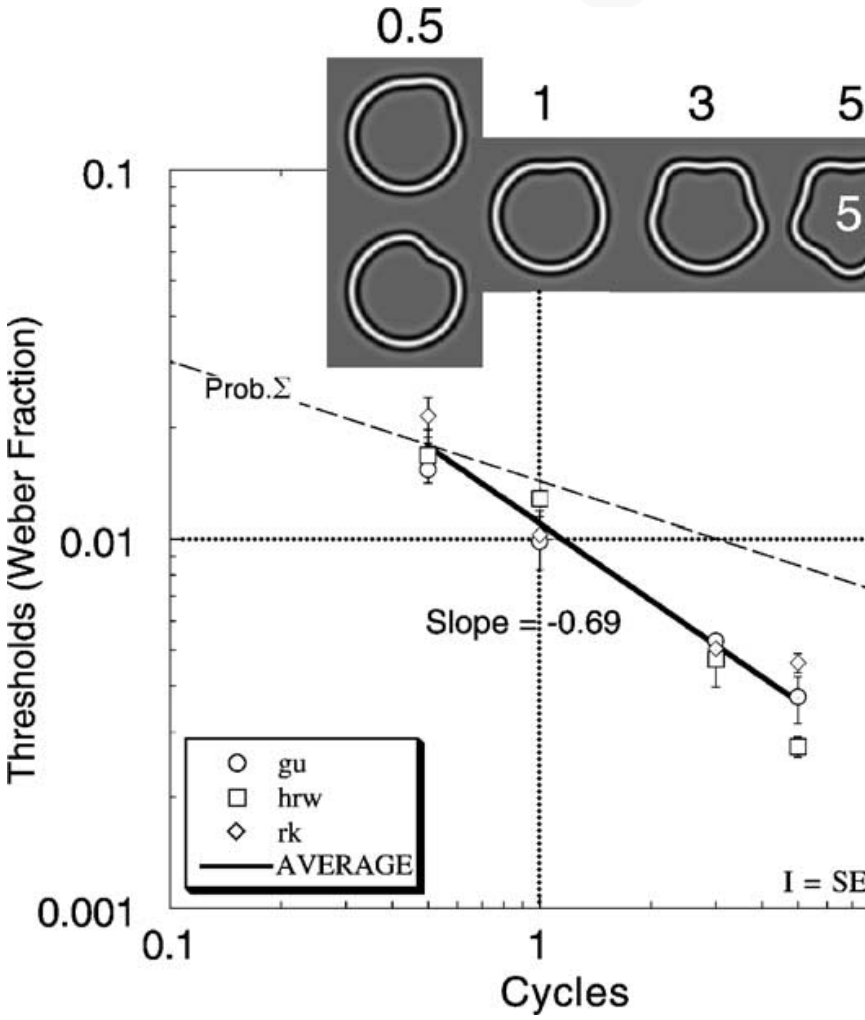


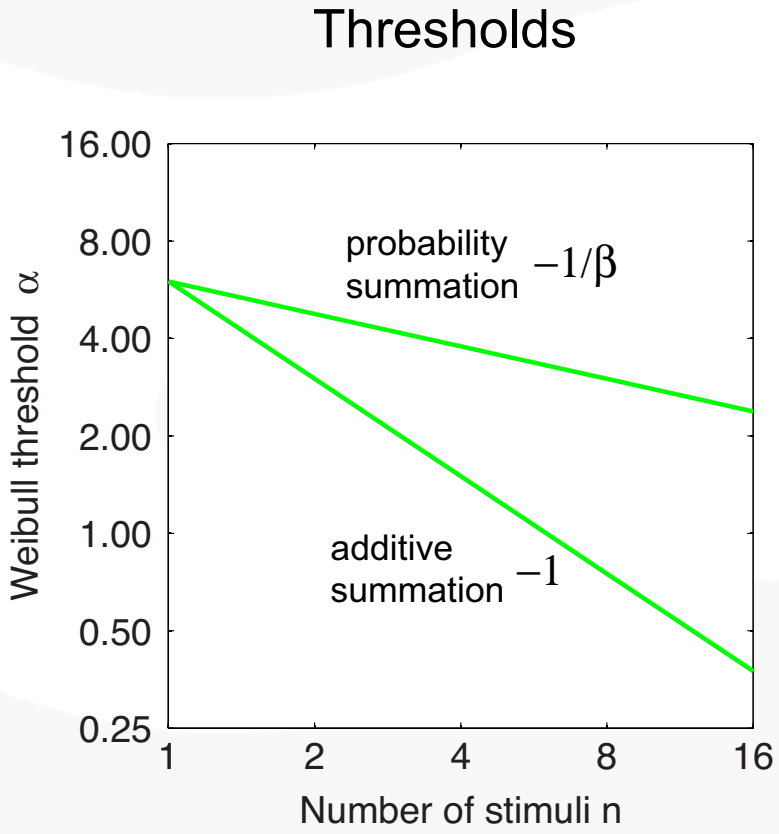
3

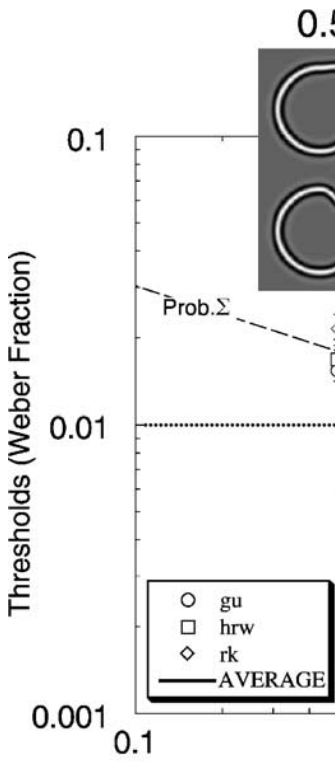
RF summation



Loffler, G., Wi
shape discrim

Hight Threshold Theory predictio

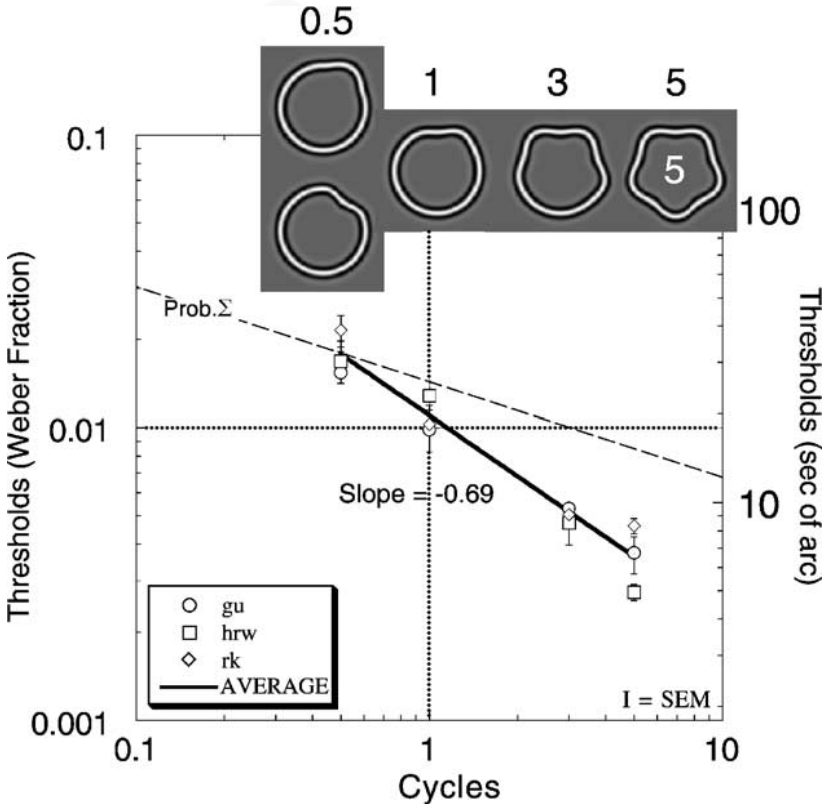


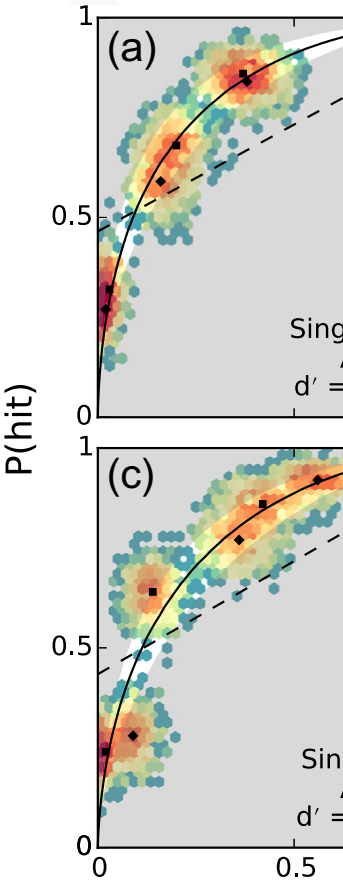


- Summation slopes are typically steeper than that predicted by proba rejected
- Under HTT the component mechanisms will be activated if their inpu
- There is almost no ‘‘penalty’’ under HTT for monitoring additional no internal noise carried by those mechanisms will have a vanishingly sr

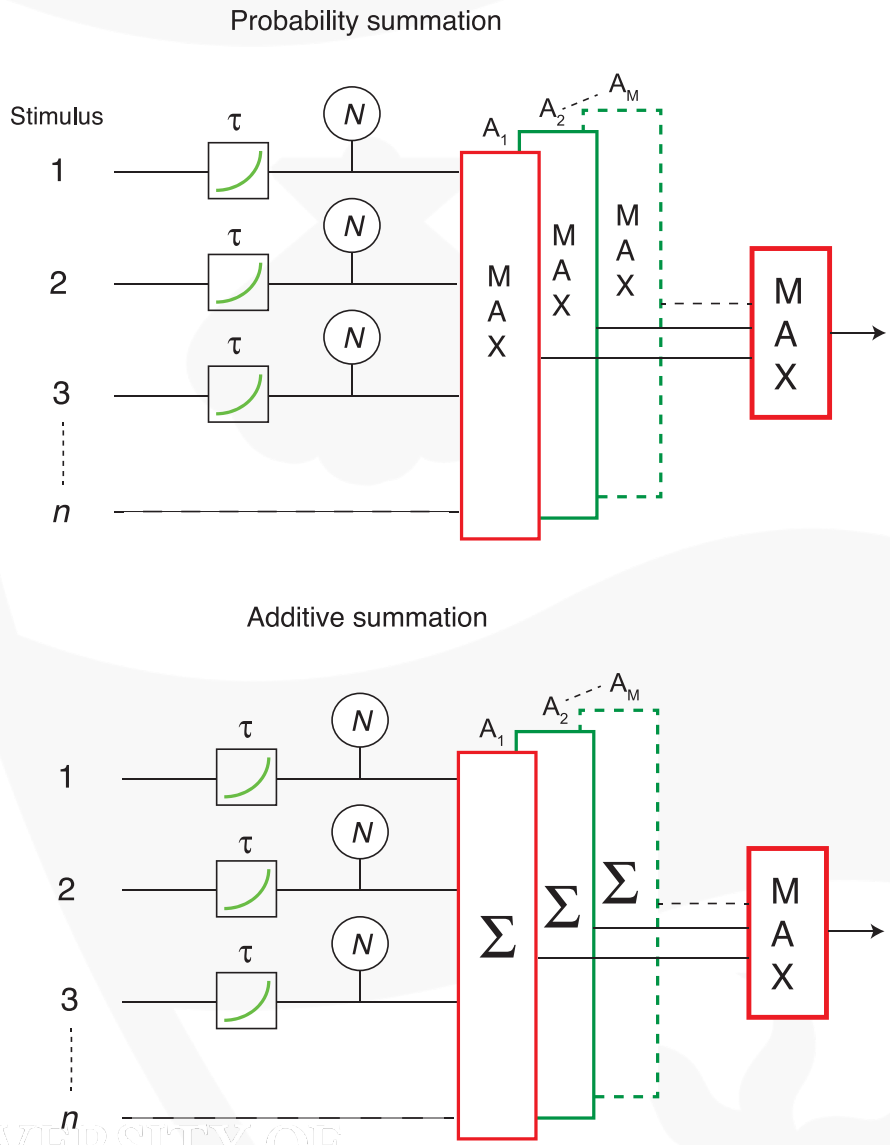
Summation under Signal Detectio

Baldwin, A. S., Schr
(2016). Rejecting p
patterns, not so Qu





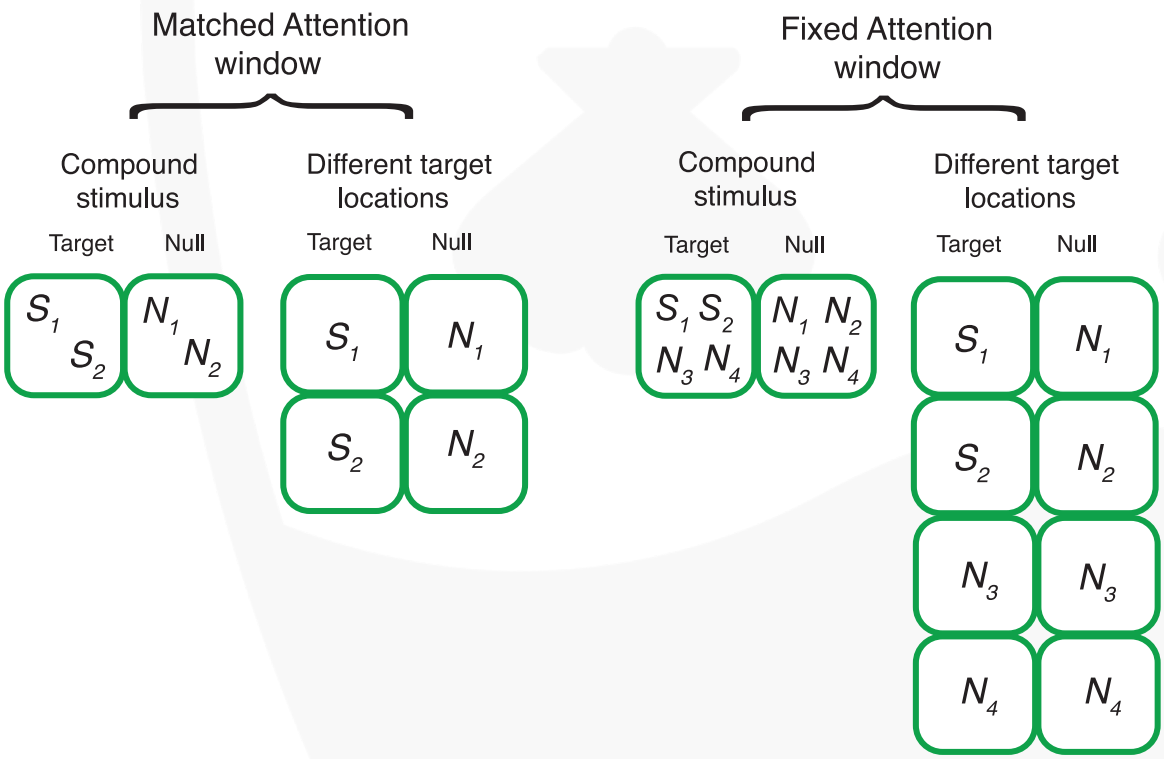
Types of summation



- N = internal n
- τ = exponent
- A_1 = the targe
- $A_2 – A_M$ = the intervals)
- M = the total forced-choice
- MAX = MAX

Kingdom, F.A.A., Ba probability and add mechanisms under *of vision*, *15*(5), 1-1.

Summation scenarios



Kingdom, F.A.A., Baldwin, A. S., & Schmidtmann, G. (2015). Modeling probability and additive summation for detection across multiple mechanisms under the assumptions of signal detection theory. *Journal of vision*, *15*(5), 1-1.

- Schematic sh
  two-interval
  interval conta
- $N_1 - N_4$ interr
  to the stimuli
- Each green b
- When the co
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- For this situa
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- When the co
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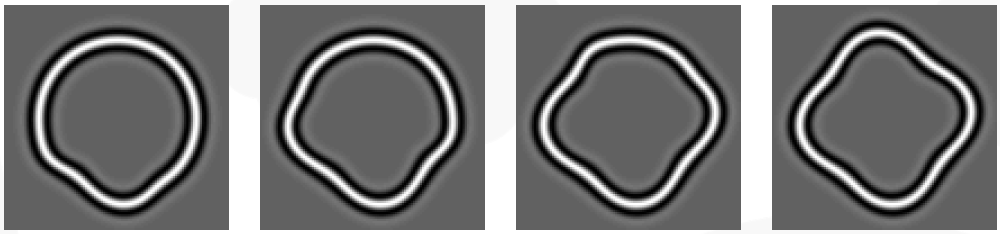
Tyler, C. W., & Che
paradigm: Attentio
summation. *Vision*

Spatial uncertainty

Change in number of modulated cycles



1 2 3 4

Threshold (x)

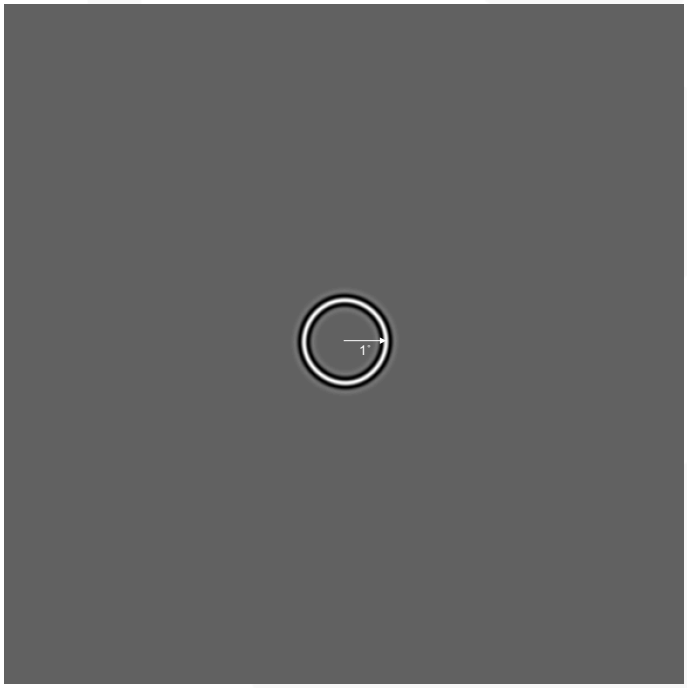
Baldwin, A. S., Schmidtmann, G., Kingdom, F. A., & Hess, R. F. (2016). Rejecting probability summation for radial frequency patterns, not so Quick!. *Vision Research*, *122*, 124-134.

Green, R. J., Dickinson, J. E., & Badcock, D. R. (2017). Global processing of random-phase radial frequency patterns but not modulated lines. *Journal of vision*, *17*(9):18, 1-11.

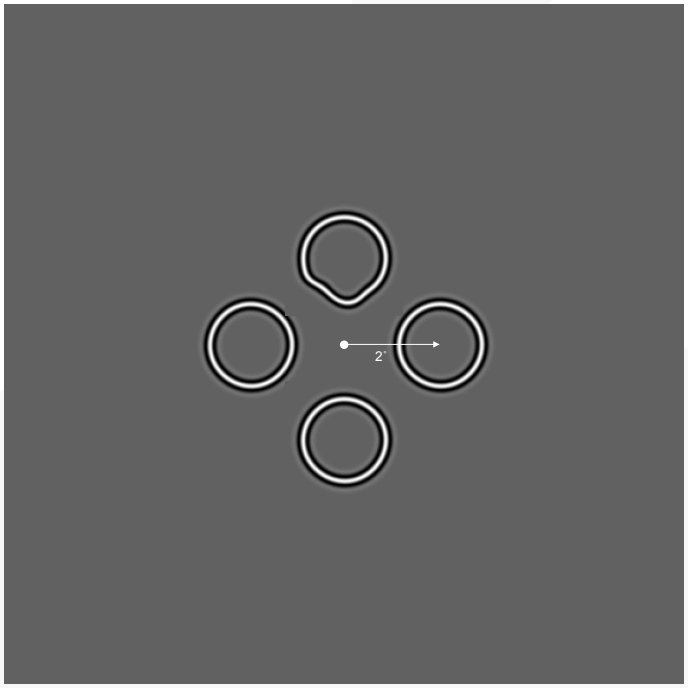
Green, R. J., Dickinson, J. E., & Badcock, D. R. (2018). Integration of shape information occurs around closed contours but not across them. *Journal of vision*, *18*(5),6, 1-13.

Stimuli

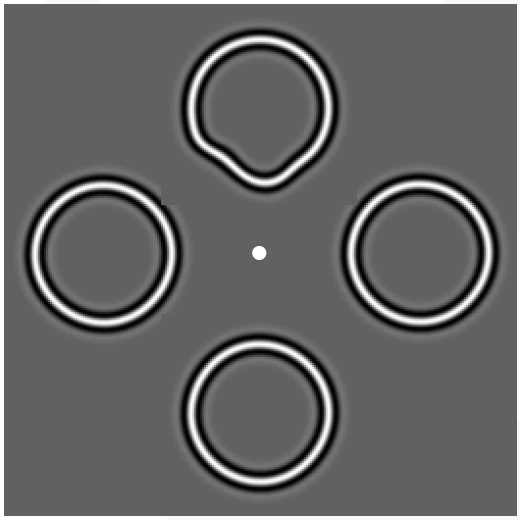
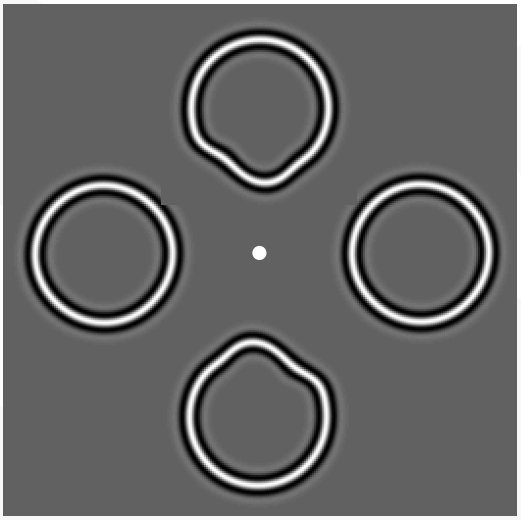
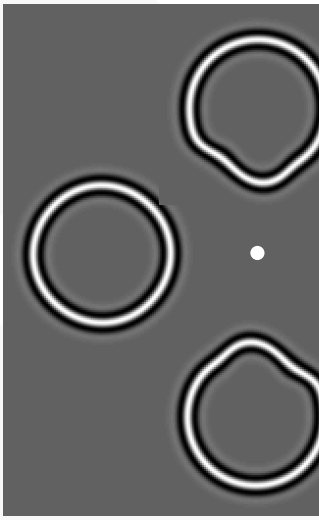
central



2° eccentricity



Fixed position and blocked (Fixed

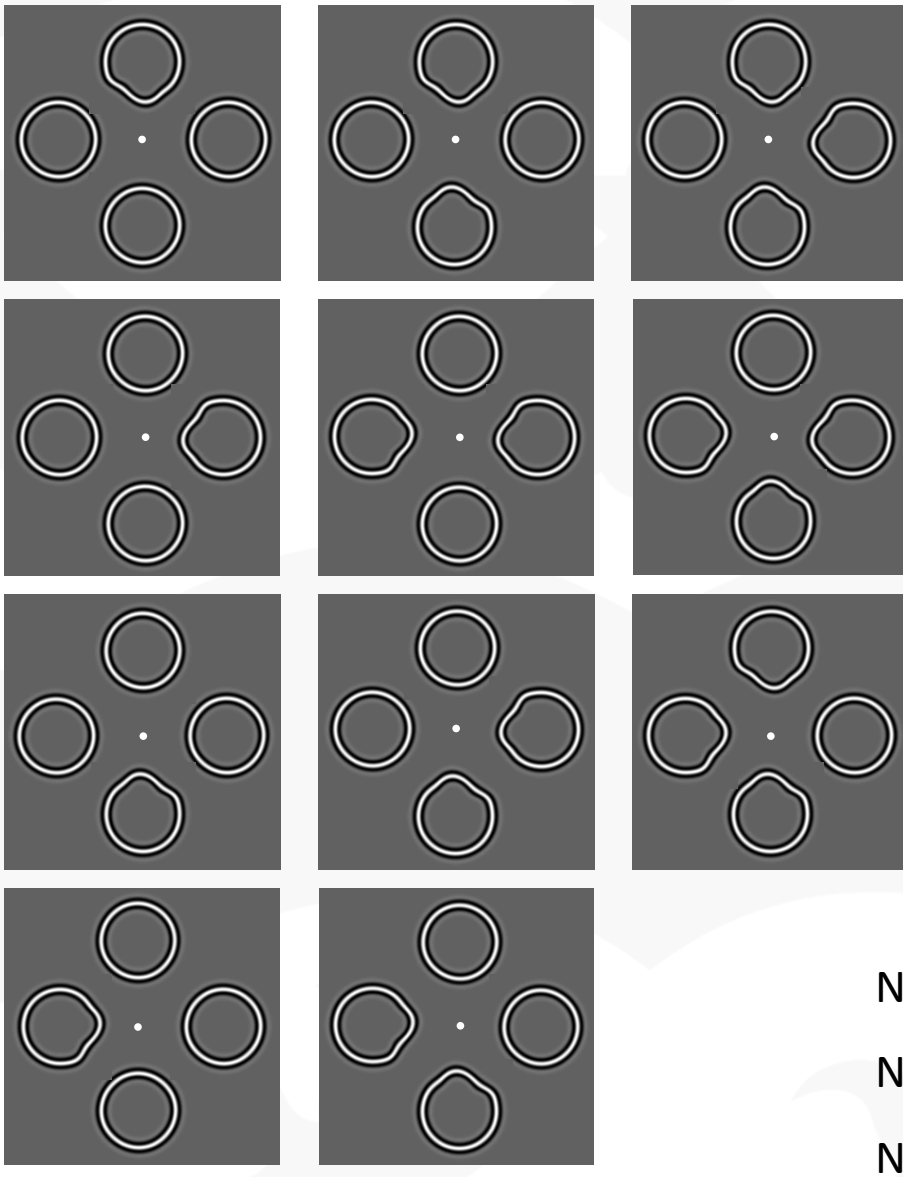




Number of monitored channels: Q =

Number of stimuli: n = [1 2 3 4]

Number of alternatives: M = 2

Variable position and blocked (Se

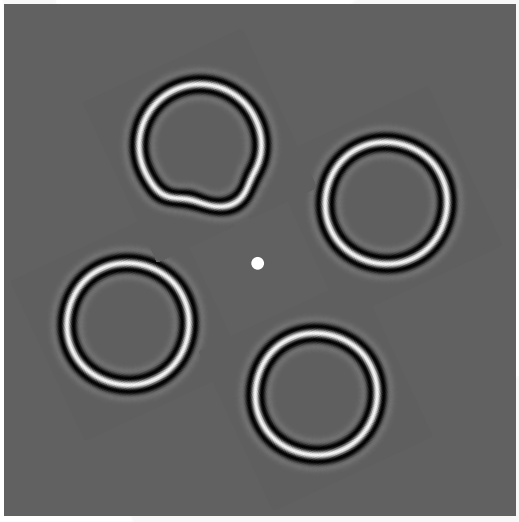


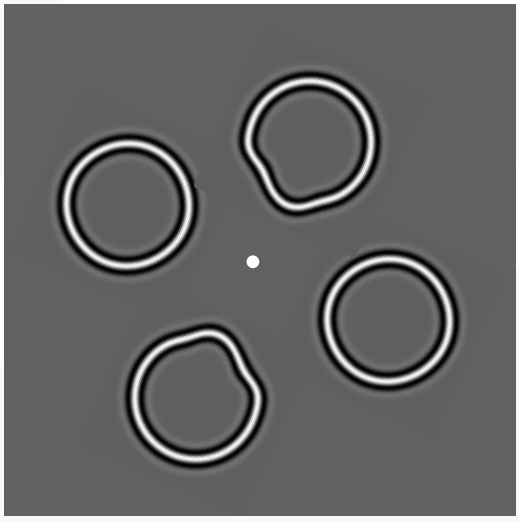
N

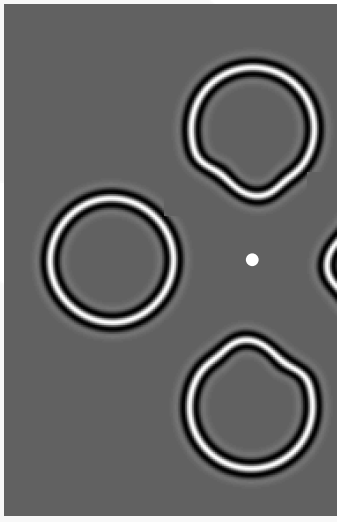
N

N

Random position and interleaved





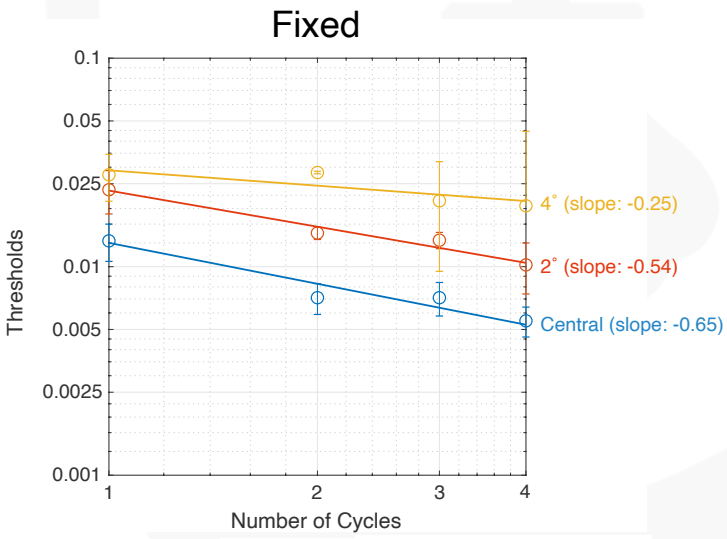


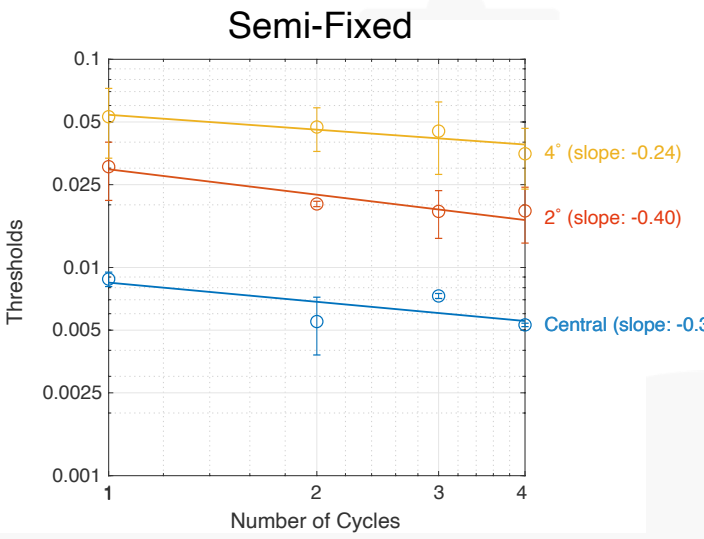
Number of monit

Number of stimu

Number of altern

Results - Thresholds





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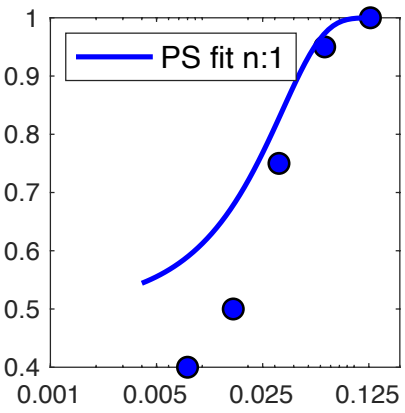
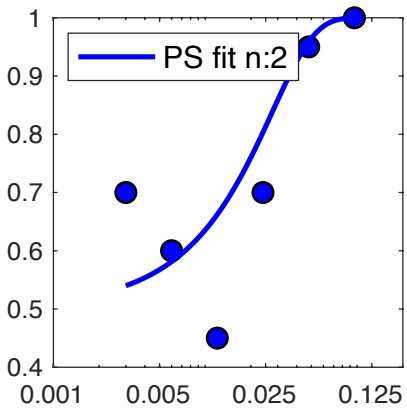
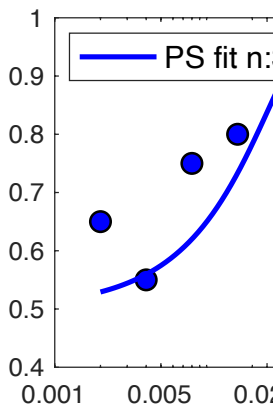
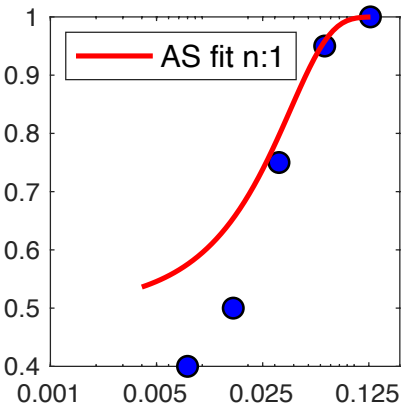
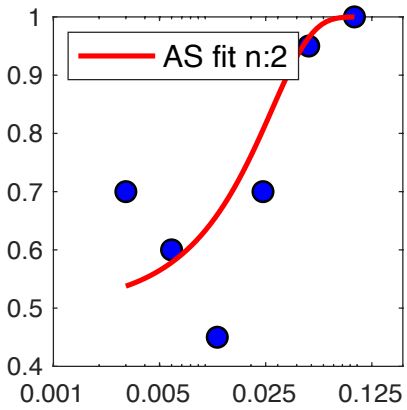
Results – Model simulations

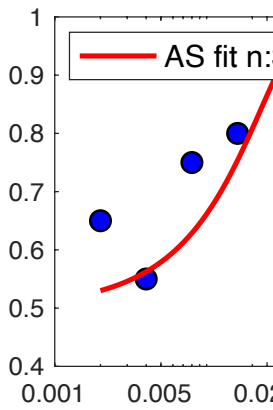




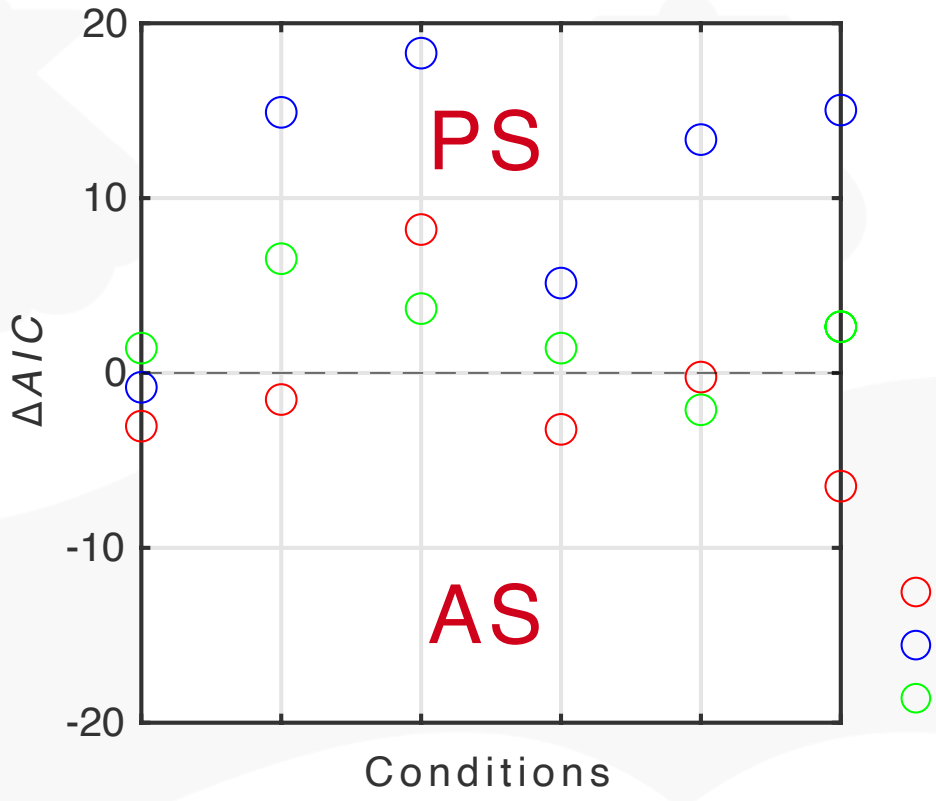








Results - Models

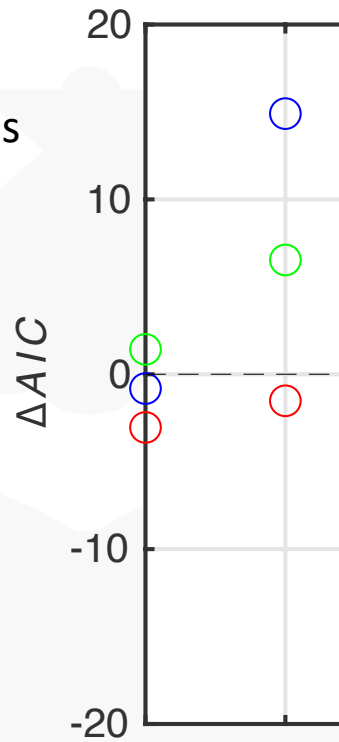


Results - Models

- The model with the smallest *AIC* values is the probability summation model
- The differences in *AIC* values between the PS and AS models are relatively small
- According to Burnham and Anderson (2004), the preferred model can be determined by calculating the difference between the AIC scores of the *i-th* model (AIC_i) and the model with the lowest AIC score (AIC_{min}) obtained from the set of models examined

$$\Delta_i = AIC_i - AIC_{min}$$

- Models with $\Delta i > 7$ can be rejected (Burnham & Anderson, 2004)



Burnham, K. P., & Anderson,
model selection. *Sociological*

Discussion

- We can not reject PS as a model
- In agreement with Baldwin et al. (2016)
- Summation is similar whether it occurs within a single shape or across shapes
- In agreement with Baldwin et al. (2016)
- Independent of eccentricity
- Largely independent of uncertainty (*cf.* Green et al., 2017, 2018)
- This implies that the visual system does not treat single closed shapes any different from various shapes distributed across the visual field.

Baldwin, A. S., Schmidtmann, G., Kingdom, F. A., & Hess, R. F. (2016). Rejecting probability summation for radial frequency patterns, not so Quick!. *Vision Research*, *122*, 124-134.

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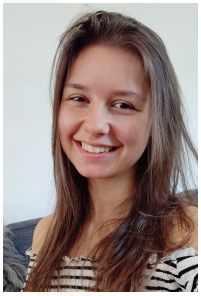

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