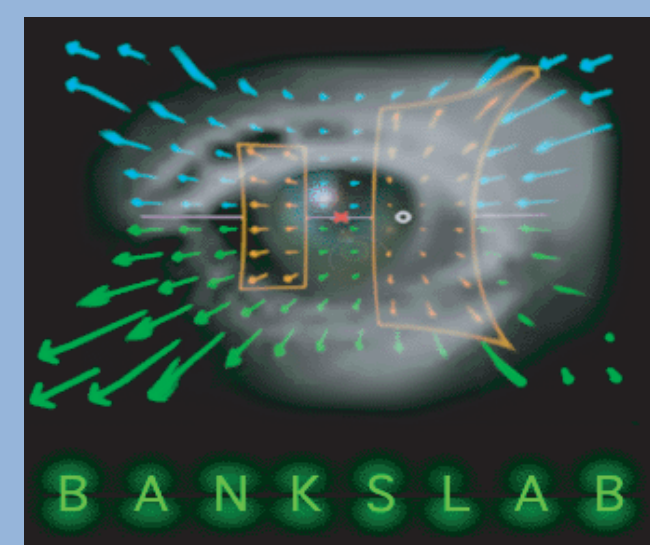


# Disparity and Texture Gradients are Combined in Two Ways

Johannes Burge<sup>1</sup>, James M. Hillis<sup>2</sup>, Michael S. Landy<sup>3</sup>, and Martin S. Banks<sup>1</sup>



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<sup>2</sup> Department of Psychology, University of Pennsylvania

<sup>3</sup> Department of Psychology and Center for Neural Science, New York University

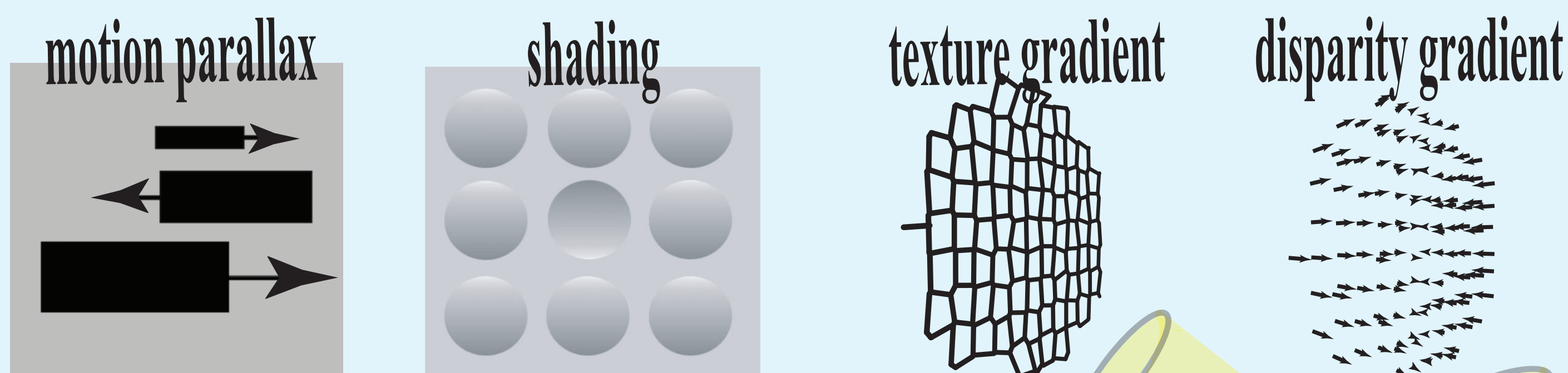


## Background

### Multiple cues are relevant for 3-D perception

Are cues combined? How?

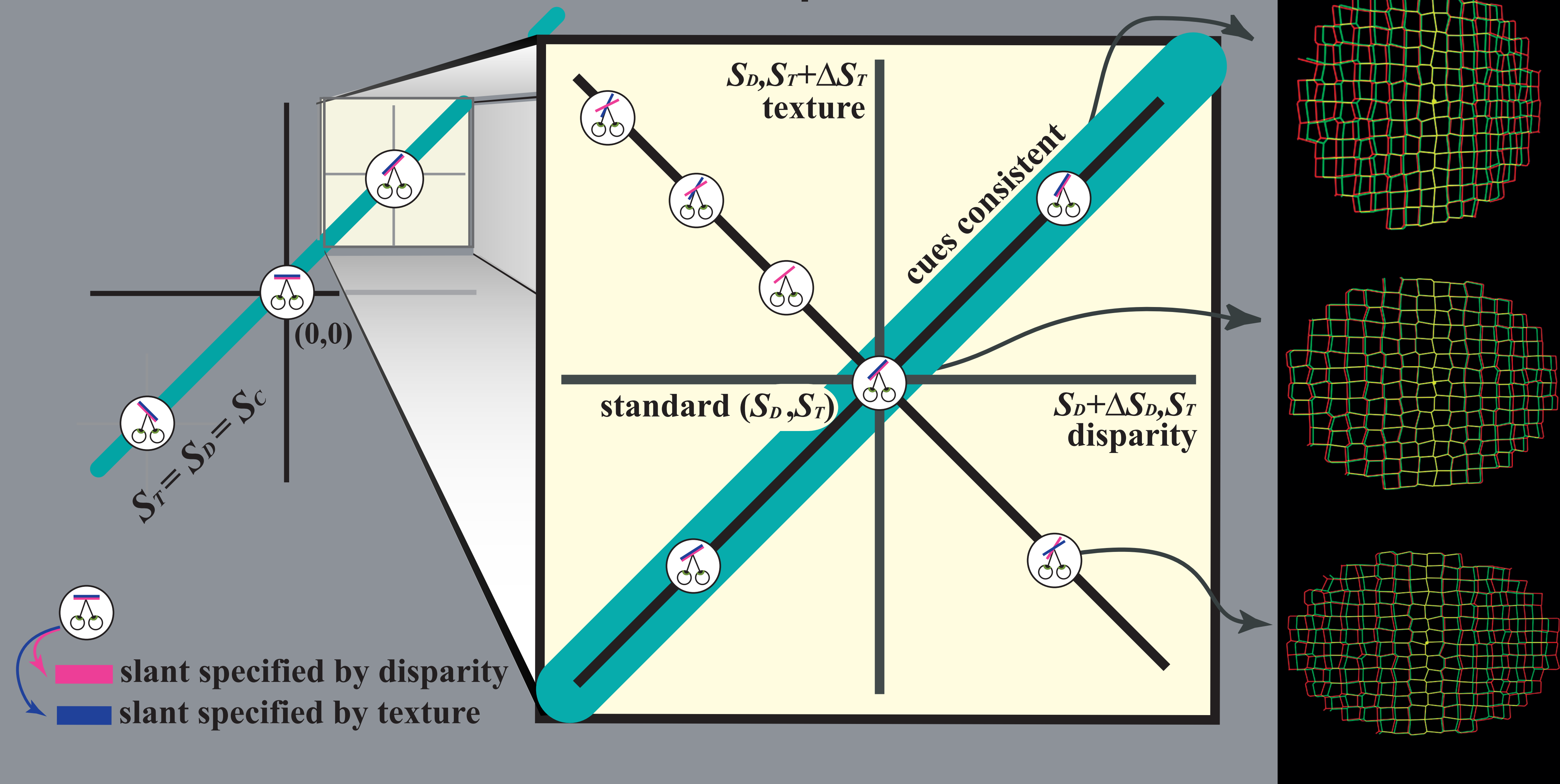
Is access to individual cues lost?



Where does conscious perception have access?

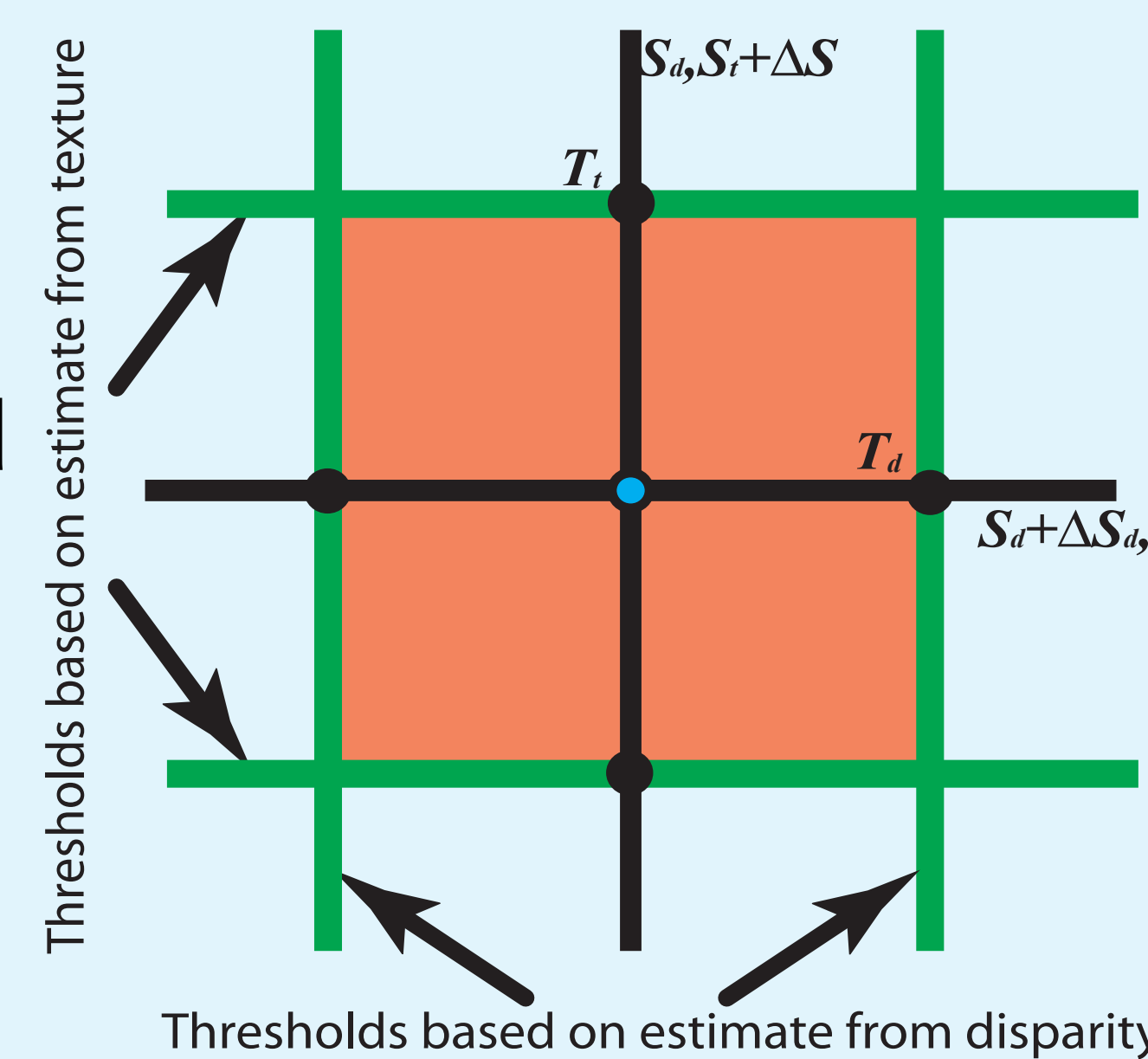
Hillis et al. (2002) found evidence that cues (disparity & texture) are combined and that access to individual cues is lost.

## Stimulus Space

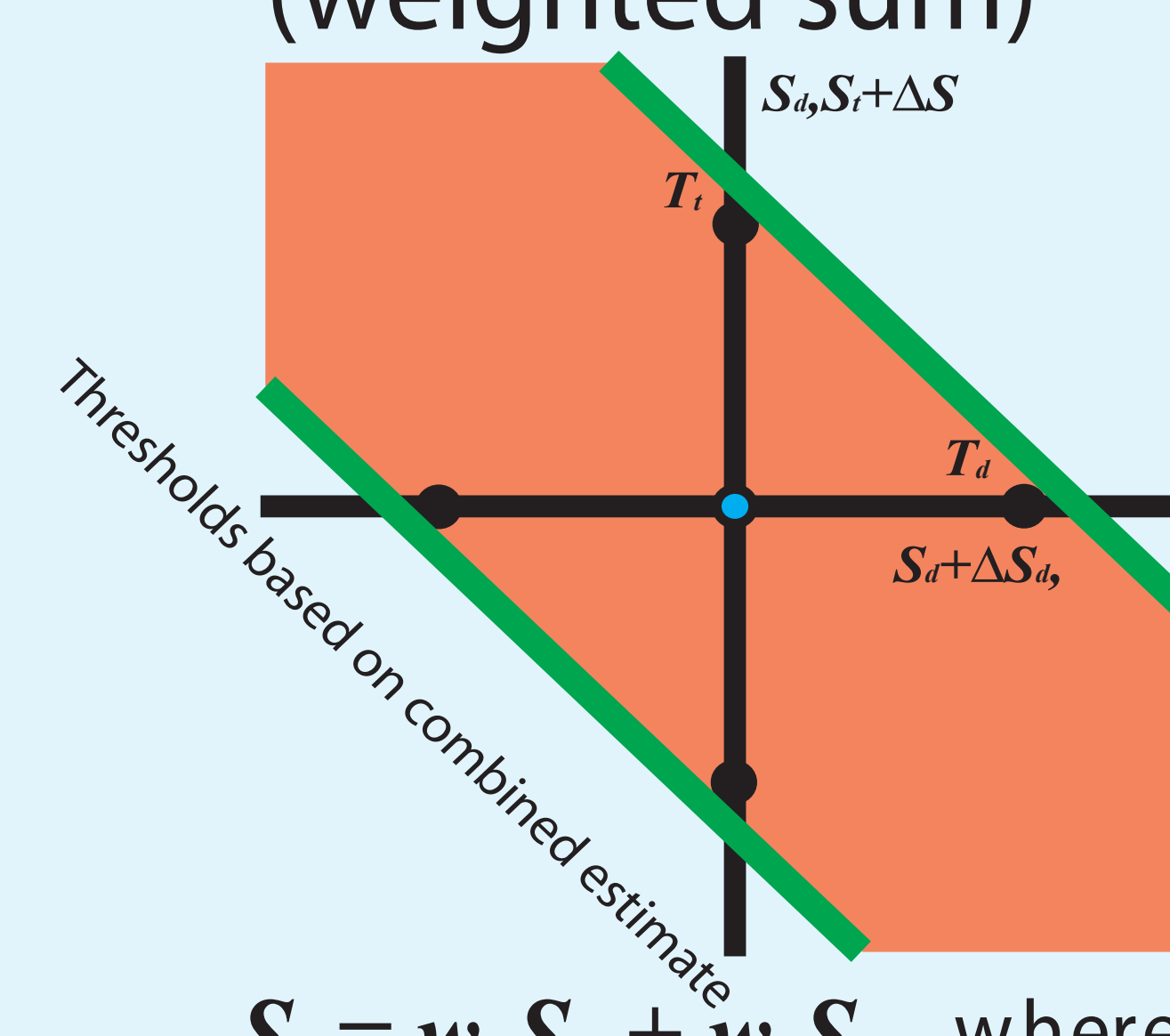


## Predictions

Thresholds for discriminating comparison stimulus displaced away from standard in various directions in stimulus space.

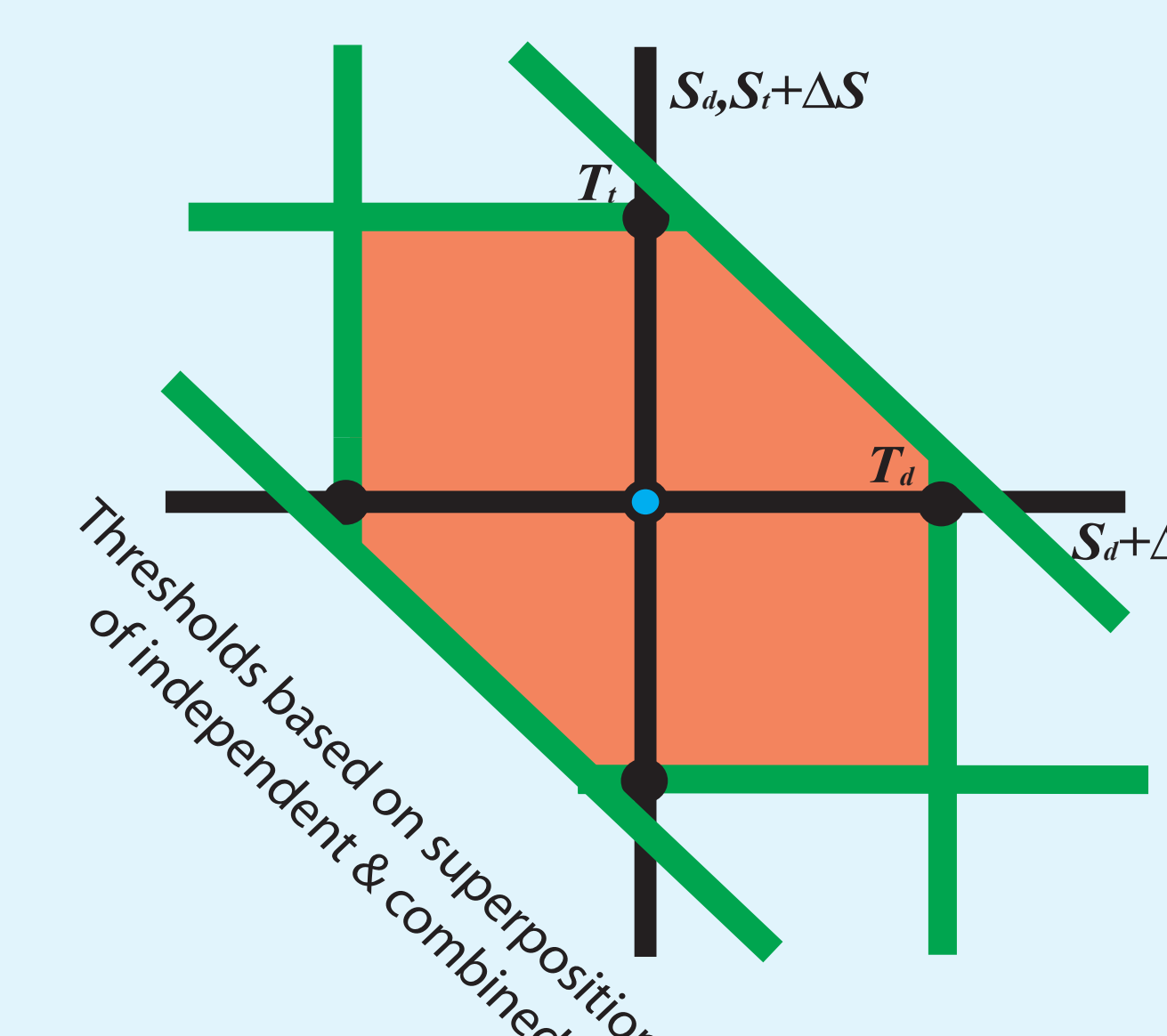


## Slant Estimator (weighted sum)



$$S_C = w_D S_D + w_T S_T \text{ where } w_D = \frac{1/\sigma_d^2}{(1/\sigma_d^2) + (1/\sigma_t^2)} \text{ \& } w_T = \frac{1/\sigma_t^2}{(1/\sigma_d^2) + (1/\sigma_t^2)}$$

## Independent & Combined



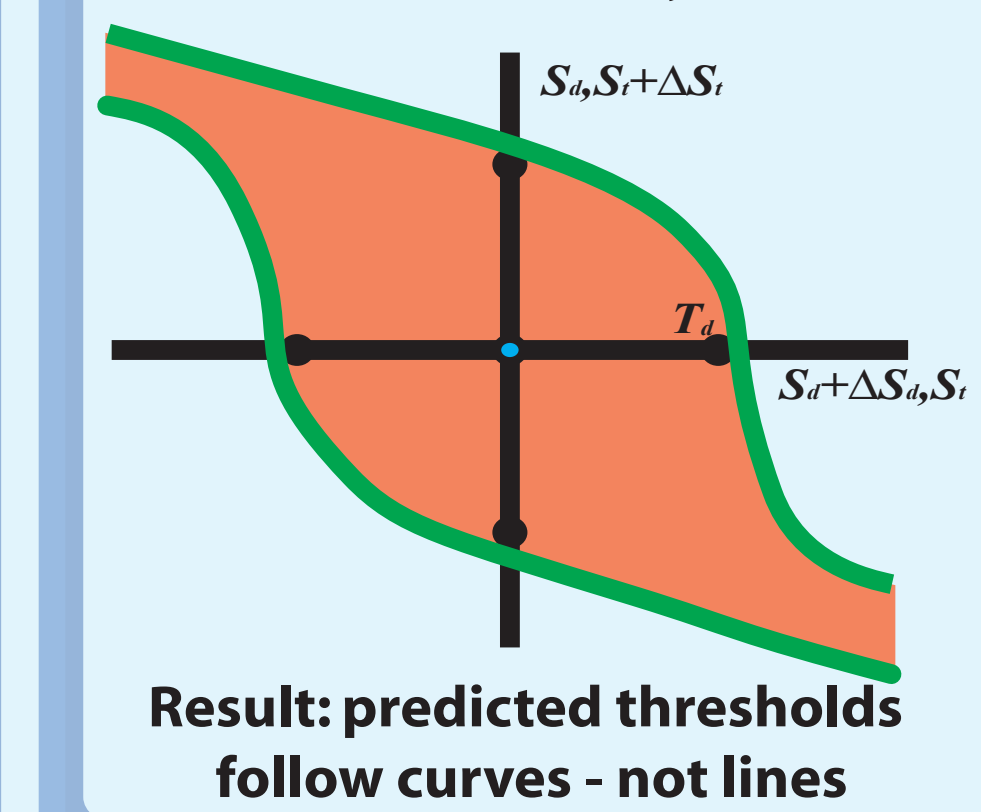
## Questions & Data

Hillis et al found texture and disparity cues combined via a weighted sum.

Data not fully explained by presence of only one estimator.

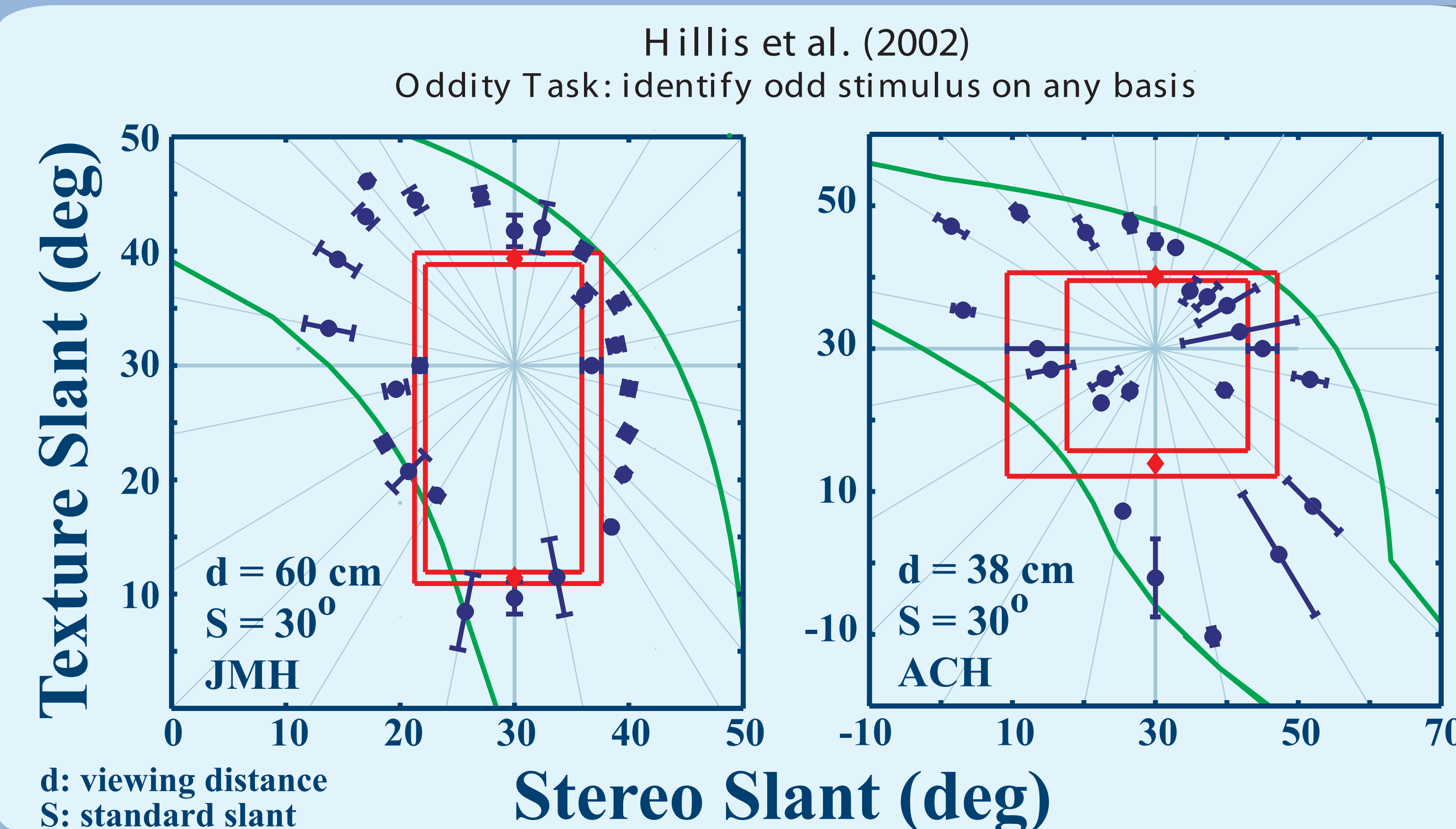
curved thresholds?

Relative reliabilities of disparity and texture cues vary with slant



Perhaps texture anisotropies perceived where elongation expected from slant estimator.

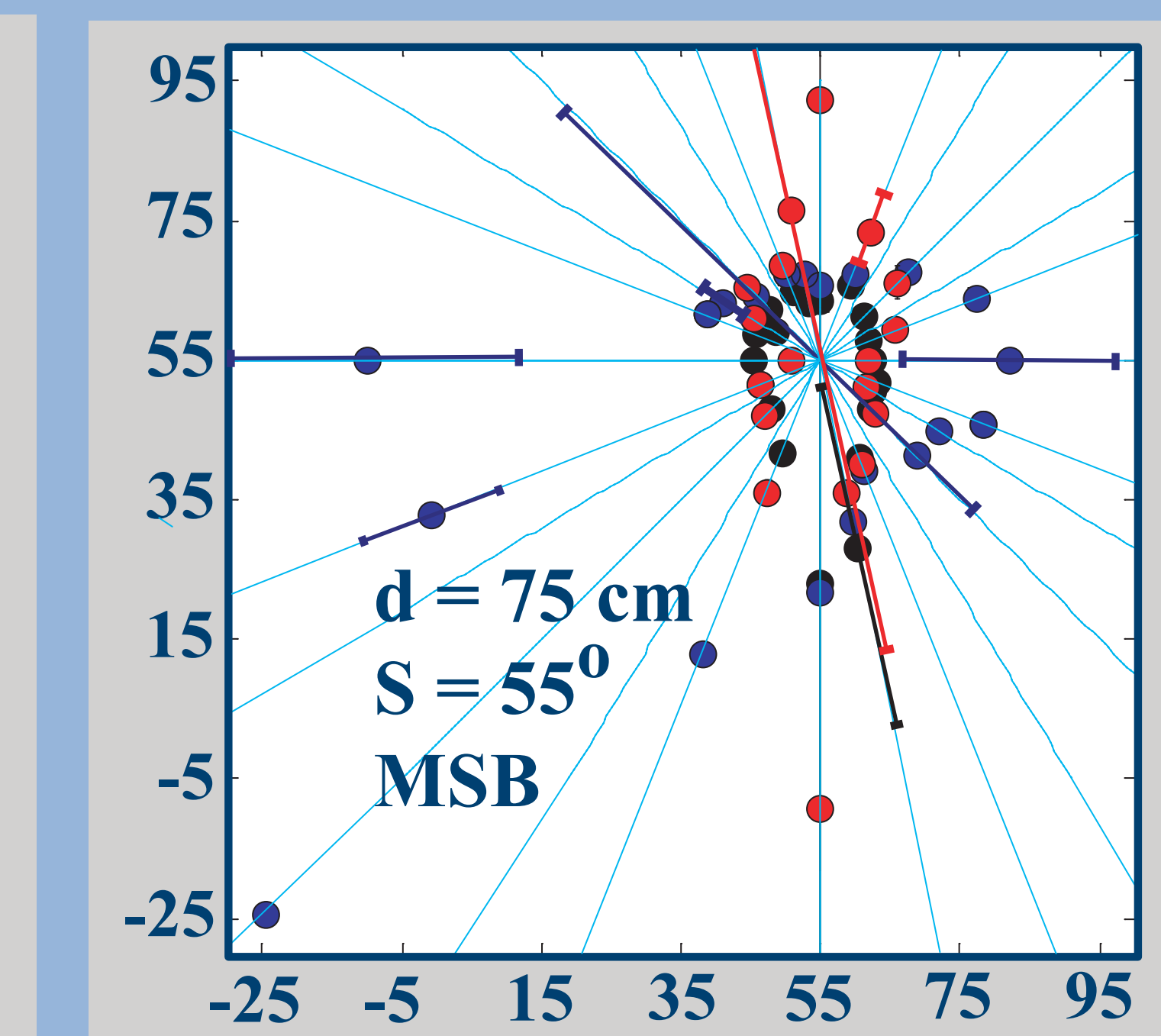
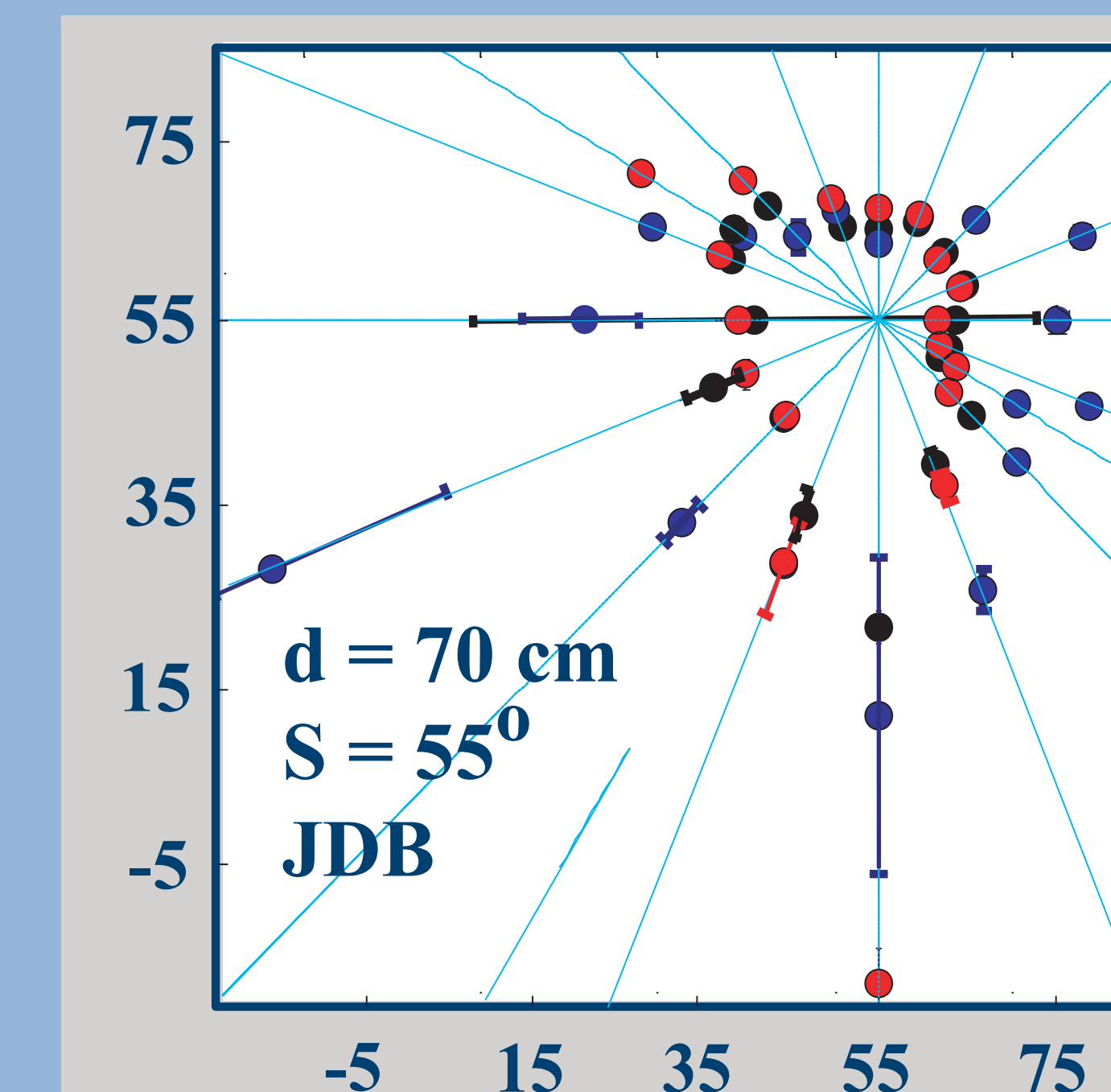
Can two mechanisms (slant estimator and texture anisotropy detector) explain response pattern?



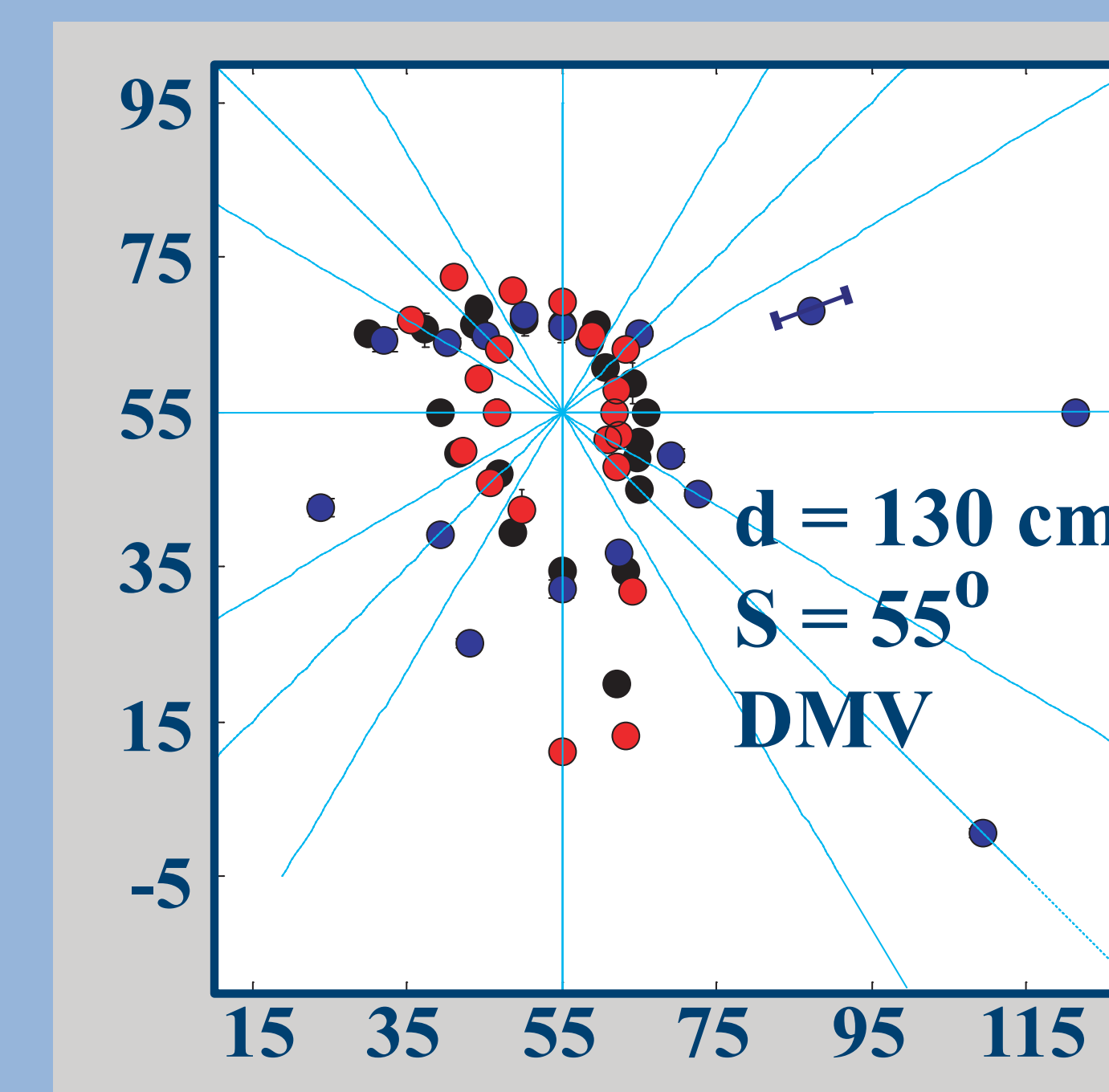
## Data

Oddity ● Slant ● Texture ● Anisotropy

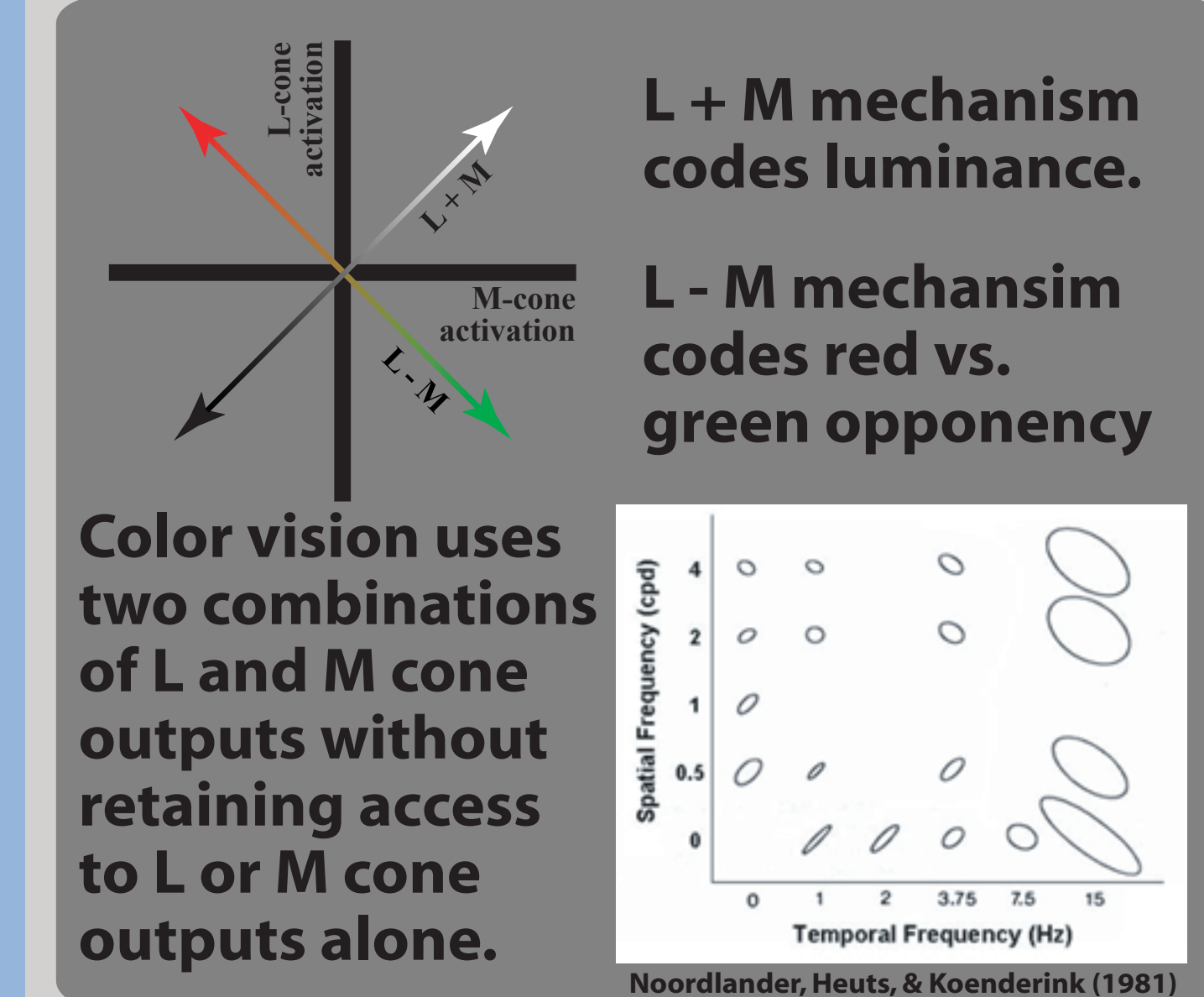
S: standard slant, d: viewing distance



Texture Slant (deg)

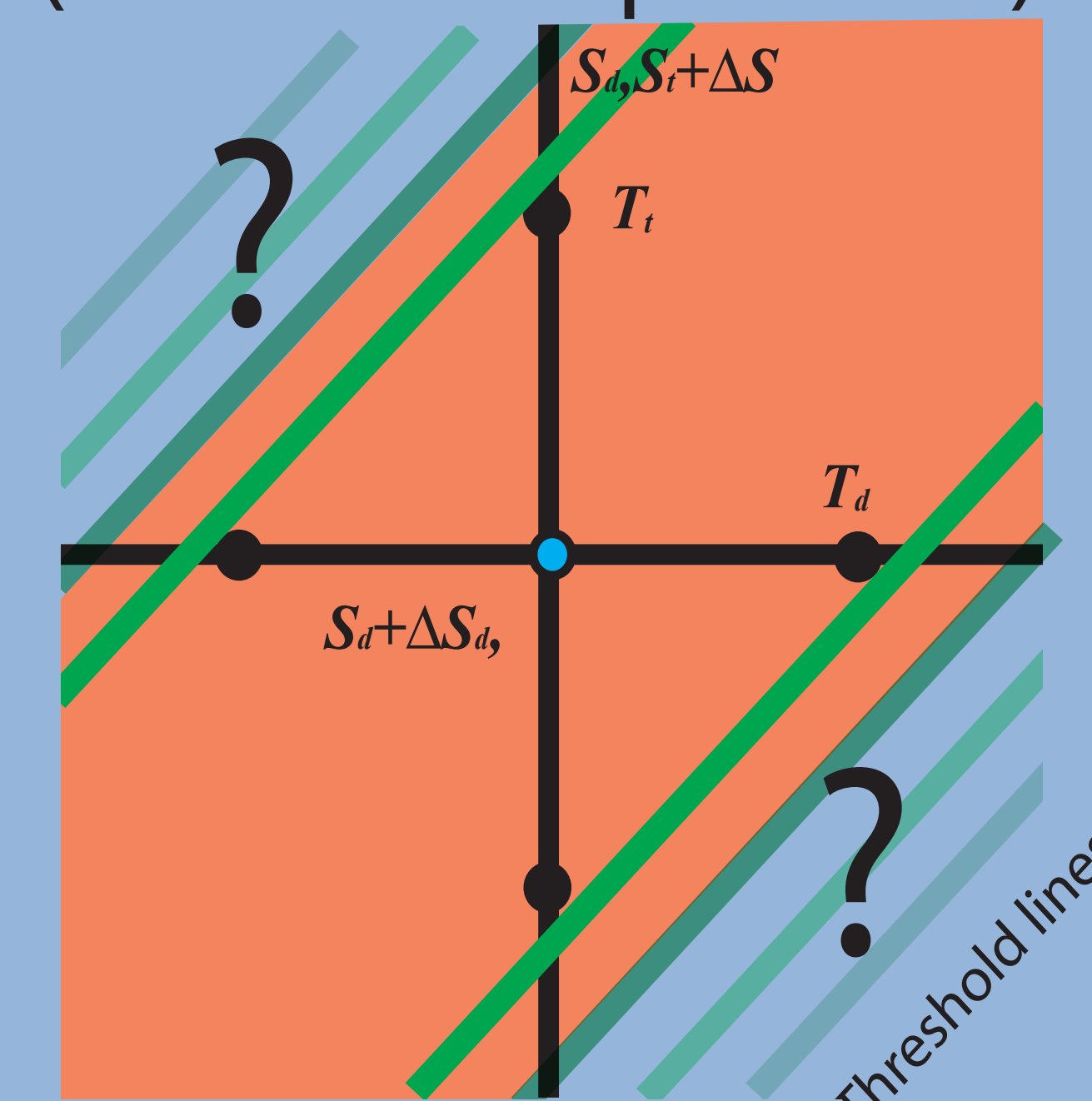


## Color Vision Analogy



## Stereo Slant (deg)

## Anisotropy Detector (difference operation)



When texture is isotropic:  $S_T = S_C$   
How can anisotropic textures be detected?  
1) Compare slant from disparity to slant from texture (i.e.  $S_D - S_T$ ).  
2) Compare cue-combined slant estimate to slant from texture ( $S_C - S_T$ ).

Are the discrimination contours from Hillis et al.'s oddity task simply the combination of a slant estimator and a texture anisotropy detector?

## Method

- 3 interval forced choice
- 2-down, 1-up staircase
- 1.5 second presentation
- No feedback
- Three perceptual judgments made in separate tasks
  - a) Oddity: Select different surface by any criteria
  - b) Slant: Select surface with different slant
  - c) Anisotropy: Select surface with different texture or different texture element distribution

## Conclusions

