

Early sensory processing of a feature is modulated by the feature's contribution to high-level object perception

Hellen Jing Yuan¹, Elisabeth Van der Hulst²,

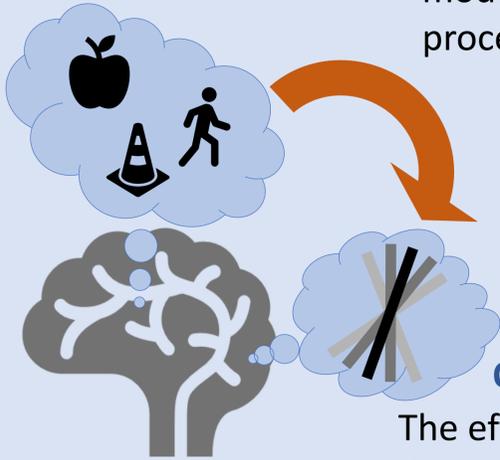
Elisabeth Von Dem Hagen¹, Johan Wagemans², Christoph Teufel¹

¹ Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, Cardiff, UK

² Laboratory of Experimental Psychology, Department of Brain and Cognition, KU Leuven, Leuven, Belgium

1 Background

High-level object percepts modulate early visual processing^{[1][2]}. But how?



Conflicting findings on whether global percepts sharpen or dampen sensory processing of low-level local features^{[3][4]}.

Our reconciling hypothesis:

The effect of top-down modulation is dictated by whether the local feature contributes to the global percept.

2 Online psychophysics experiment

Measured sensitivity to local orientations within a dynamic point-light walker.

2 conditions to manipulate local features' contribution to the global percept

2 baseline conditions

N = 101

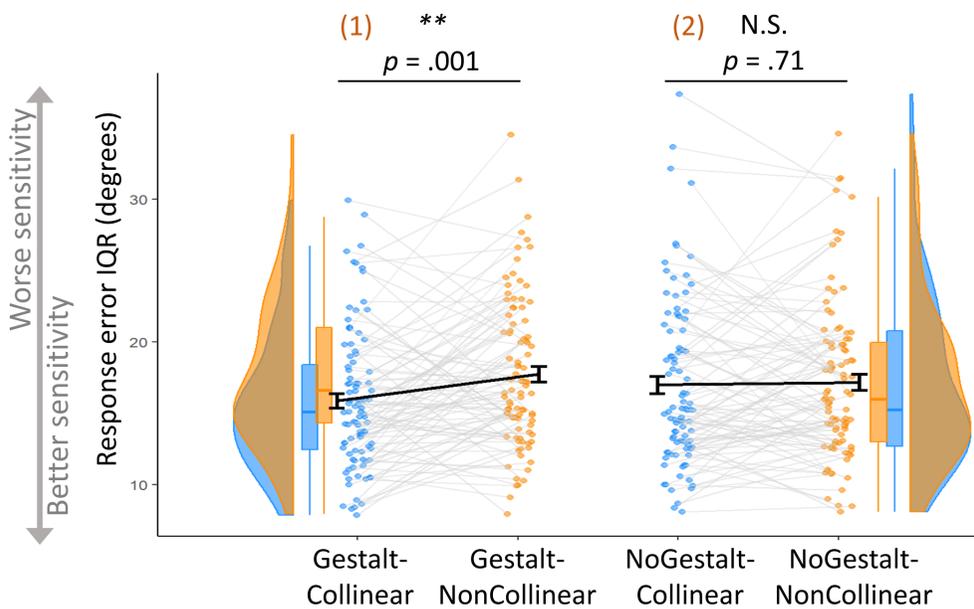
(A shorter version of this task with N = 212 showed similar results overall)

	Collinear	NonCollinear
Gestalt		
No Gestalt		

3 Differential top-down modulation

(1) Better sensitivity to contributing features than to non-contributing features.

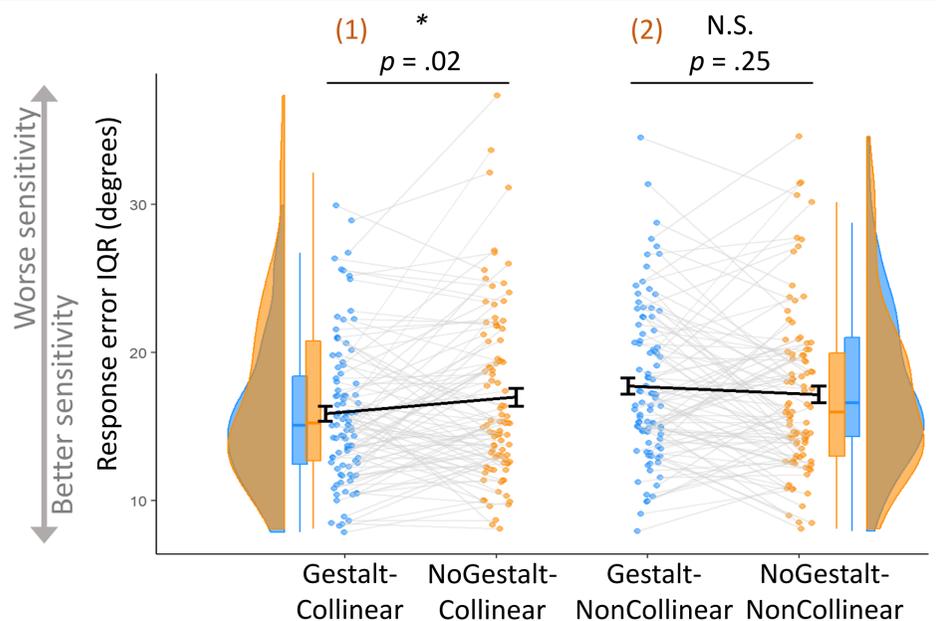
(2) This can't be explained by differences in local alignment.



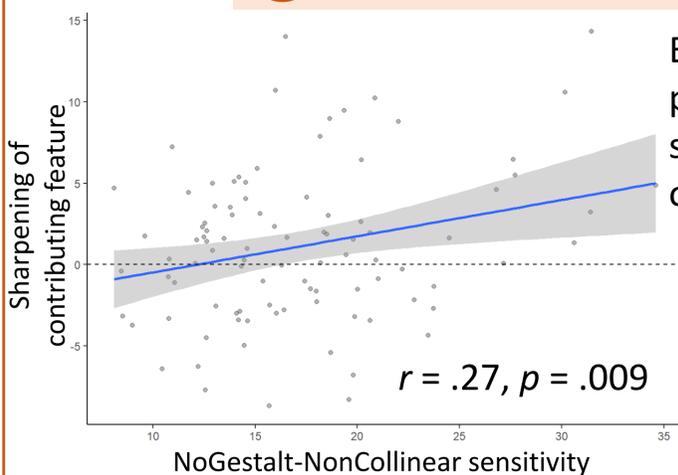
4 Underlying mechanism

(1) Sensitivity to contributing features was sharpened.

(2) Sensitivity to non-contributing features was not dampened (compared to baseline sensitivity).



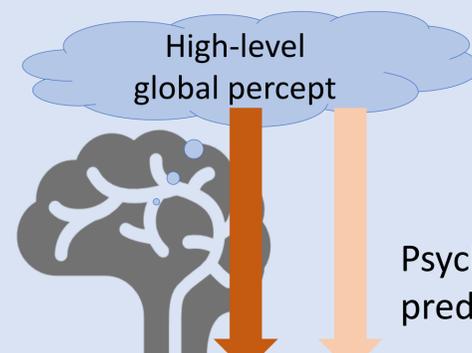
5 Individual differences



Extent of top-down processing is related to sensory precision in local orientation processing.

→ Bottom-up/top-down balance is dictated by the reliability of sensory processing.

6 In summary



Top-down modulation is moderated by dynamic interactions between high- and low-level visual processing.

Psychophysical evidence for predictive processing models.

Contributing local features → Sharpened sensitivity
Non-contributing local features → Unchanged sensitivity

Contact me:

✉ YuanJ12@cardiff.ac.uk

🐦 @JingHellen

References: [1] de Lange, F. P., Heilbron, M., & Kok, P. (2018). How Do Expectations Shape Perception? *Trends in Cognitive Sciences*, 22(9), 764–779. [2] Teufel, C., & Fletcher, P. C. (2020). Forms of prediction in the nervous system. *Nature Reviews Neuroscience*, 21(4), 231–242. [3] Christensen, J. H., Bex, P. J., & Fiser, J. (2019). Coding of low-level position and orientation information in human naturalistic vision. *PLoS ONE*, 14(2), e0212141. [4] Poljac, E., De-Wit, L., & Wagemans, J. (2012). Perceptual wholes can reduce the conscious accessibility of their parts. *Cognition*, 123(2), 308–312.