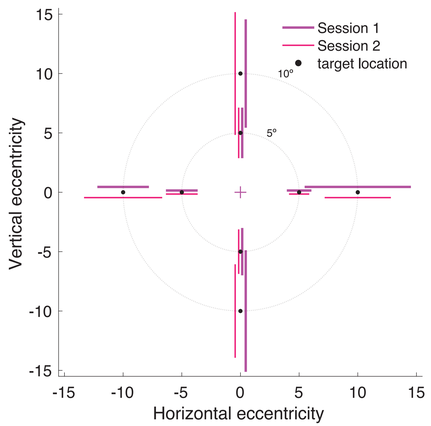
Conservation of cortical crowding distance in human V4: A replication and extension

Jan W. Kurzawski[1], Brenda S. Qiu[2], Najib J. Majaj[1], Noah Benson[2], Denis Pelli[1], Jonathan Winawer[1]

1. Center for Neural Science and Psychology Dept, NYU.
2. eScience Institute, University of Washington, Seattle, WA, USA

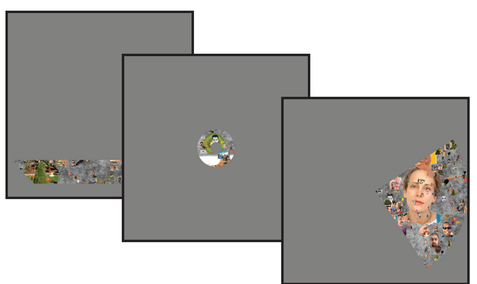
Method: Crowding distance and uncrowded array

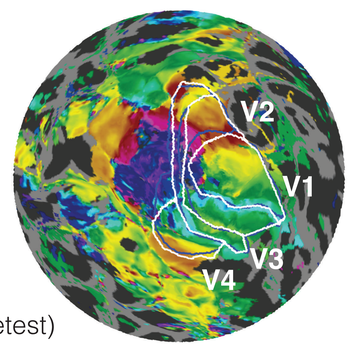


- 4 meridians
- 5° and10° of eccentricity
- 2 sessions (test-retest)
- 50 observers

We calculate λ, the number of letters that fit into the visual field without crowding

Method: Cortical map size (fMRI retinotopy)

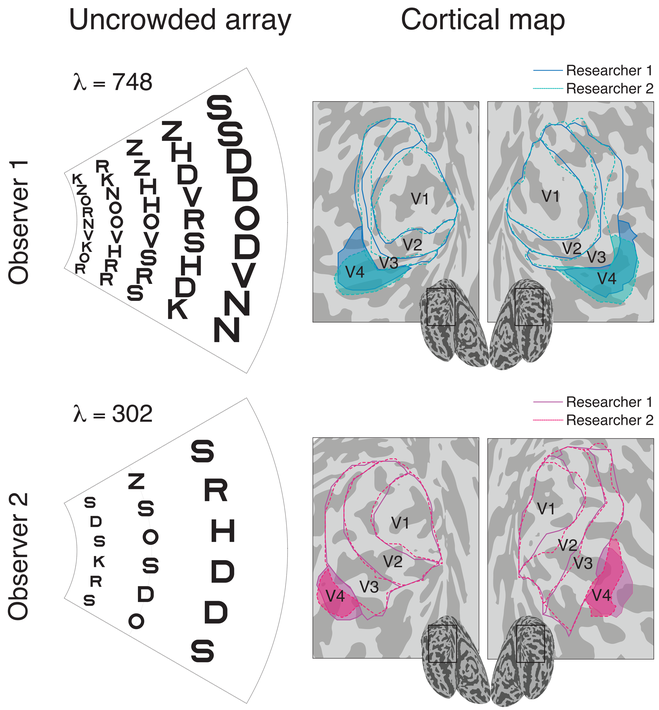




- Bar, ring, and wedge aperture
- Two researchers defining boundaries (test-retest)
- Maximum eccentricity of 12.4°
- 50 observers

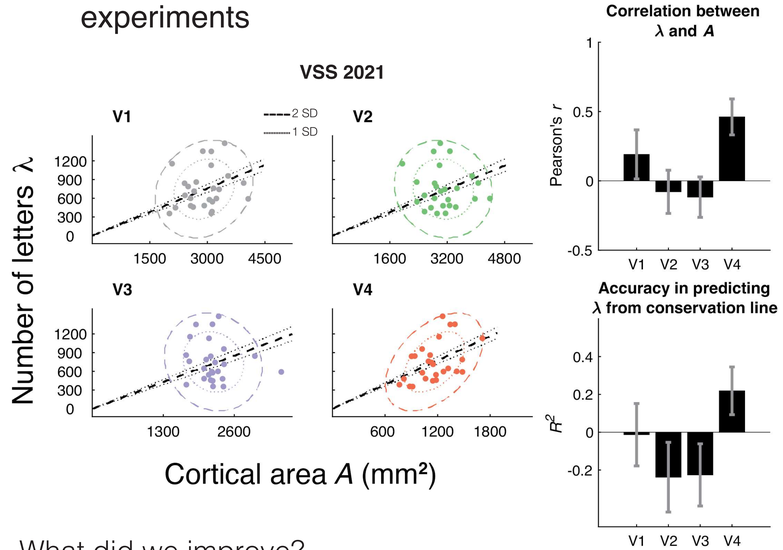
Hypothesis: Conservation implies that individual variation in λ is entirely due to variation in surface area A of one or more maps, such that observers with larger maps can recognize more letters in their visual field

Two example observers



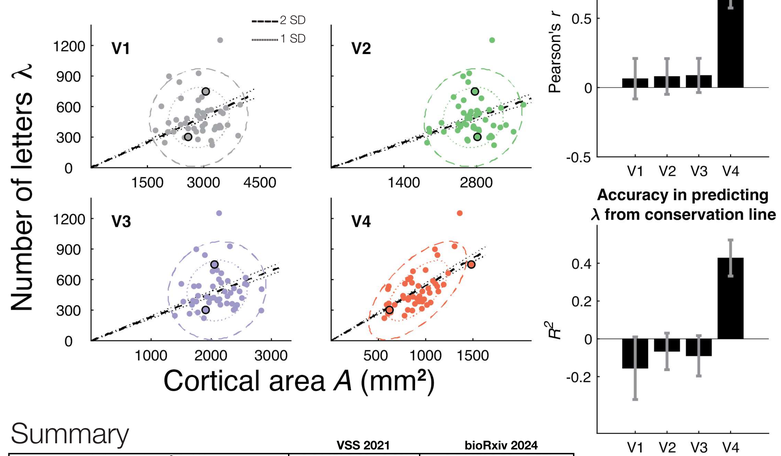
	λ	*A* (mm²)			
		V1	V2	V3	V4
Observer 1	748	3052	2767	2053	1483
Observer 2	302	2580	2815	1907	618
Ratio	**2.5**	**1.2**	**1.0**	**1.1**	**2.4**

Result: We find excelent reproducibility across experiments



What did we improve?

	VSS 2021	bioRxiv 2024
Number of participants	26	49 (50 planned)
Nature of research	Exploratory	Confirmatory
Crowding sessions per subject	1	2
Number of researchers defining map boundaries	1	2
pRF stimulus design for better mapping of the fovea	no	yes



Summary

	VSS 2021	bioRxiv 2024
k (letters / mm²) in V4	0.64 [CI 0.60 - 0.69]	0.54 [CI 0.52 - 0.57]
c (mm per letter) in V4	1.25 [CI 1.20 - 1.30]	1.36 [CI 1.33 - 1.39]
r (crowding distance, surface area) V4	0.46	0.66
R^2 (conservation prediction), V4	0.22 [CI 0.09 - 0.33]	0.43 [CI 0.33 - 0.50]

Preprint