Application of fMRI adaptation to characterize the neural representation of color

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- Color names divide the continuous spectrum of color into discrete categories.
- Does the neural representation of color become more categorical along the cortical visual pathways?

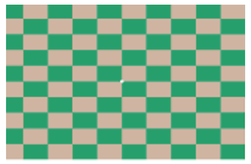
1 2 3 4 5 6 7 8 9 10

...0163815158000236743006780003...

k=11, n=3 De Bruijn cycle

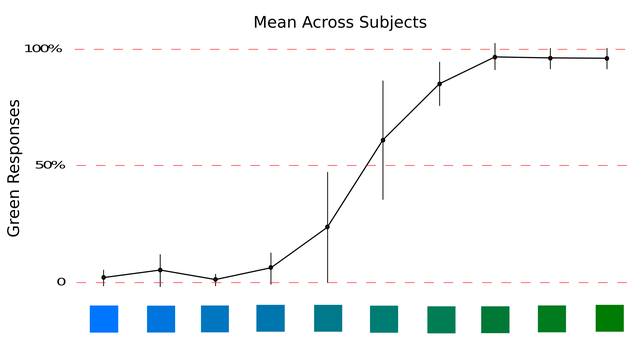
Stimulus: counter-phase flickering (5Hz) checkerboard for 1100 ms

Task: monitor for intermittent flicker of fixation dot

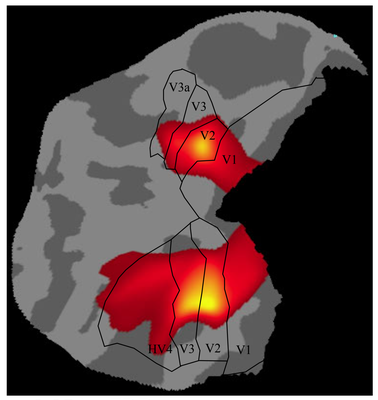


- Ten subjects. BOLD fMRI, 3T, 3mm voxels
- 55 minutes of Color Adapt scanning (plus retinotopy and a “color localizer”)
- Model both the “direct effect” of a color upon neural response and the “carry-over effect” of the prior stimulus

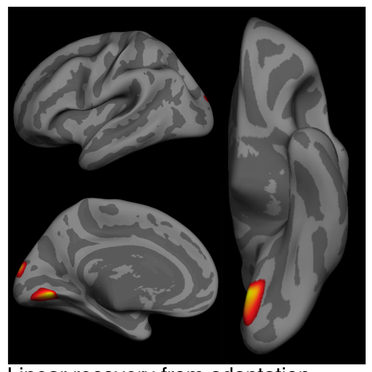
Separate behavioral experiment measured blue/ green color naming for the same subjects and stimuli



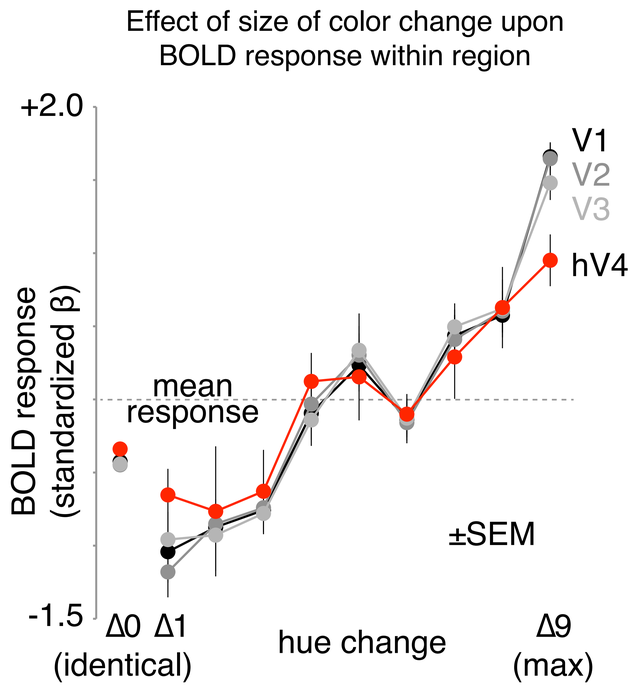
Hue change produces recovery from adaptation well fit by a linear model



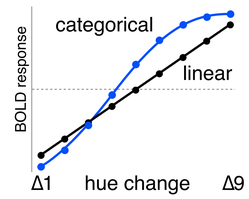
q=0.05 by FDR



Linear recovery from adaptation
p<0.05 map-wise by permutation



Linear model is better than categorical in V1-V3



Avg proportion of variance explained

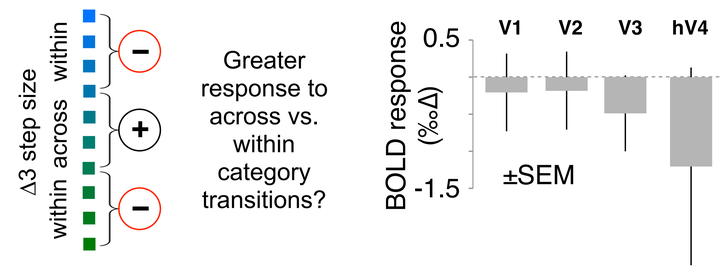
	V1	V2	V3	hV4
linear	0.64	0.66	0.60	0.31
categorical	0.57	0.59	0.55	0.29

p=NS

linear > categorical at p<0.005

Interaction of lin > cat with V1 vs hV4: p=0.07 (two-tailed)

No difference across the categorical boundary



No cross-boundary effect was found within visual area regions or in a whole brain analysis (FDR q=0.05 level)

Summary

- Variation in hue (blue ↔ green) is represented by linear variation in neural similarity within cortical areas V1-V3.
- Within area hV4, both a linear and a categorical model of neural similarity performed equally poorly
- Δ3 transitions within and across the categorical boundary did not differ in responses within V1-hV4 or elsewhere in a whole-brain analysis
- Neural features of categorical color perception were not found during viewing of colors without explicit reference to category

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