At What Stage in the Human Ventral Pathway is the Greater Sensitivity to Nonaccidental over Metric Properties First Manifested?

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Background

NAP: Nonaccidental property variations are those that are primarily unaffected by rotation in depth.

MP: Metric property variations are those affected by rotation in depth.

Behavioral evidence for greater sensitivity to NAPs than MPs:

Match-to-sample task in which the matching stimulus was identical to the sample: Higher accuracy when distractors differed from matching stimuli in a NAP than an MP. (Physical differences were equal.)

Single cell recordings:

Macaque IT cells show, on average, higher modulations to NAP changes than to equally large pixel-wise changes of both MP and view changes (not shown), i.e. the same object rotated in depth.

Effects of rotation in depth:

Same-Different matching of depth-rotated novel objects is easier when the objects differ in a NAP than an MP. (Equal performance at 0 deg because physical differences of MPs > NAPs.)


Subjects viewed animations of two geons, cycling back and forth for four cycles (.5 sec/geon) for a total of 4 sec. A block was composed of five such movies for a total duration of 22 sec. All movies in a block generated the same kind of variation: either NAPs, MPs, or Rotations in Depth.

The Design:

The task was to detect (by button press) a repeat of a flip movie within the block (which occurred 20% of the time).

Results:

NAP differences produced greater BOLD responses than MP differences, particularly in early visual areas (V1/V2), suggesting greater sensitivity to NAPs than MPs.

Conclusions:

- IT tuning and behavioral discrimination performance indicate that NAP variations are markedly more salient than MP changes.

- The greater sensitivity of NAPs over MPs—as indexed by release from adaptation—may arise as early as V1.

- In pFs, NAP variations produced greater fMRI release-from-adaptation effects compared to MP variations, although only marginally.

References:

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An fMRI-adaptation study comparing sensitivity to NAPs and MPs (and Rotation in depth).

The Conditions:

All three variations were matched in terms of the amount of pixel energy change.

The only variations were parallelism and curvature. Other NAP variations would produce a different number of vertices and lines.

Effects of rotation in depth:

Same-Different matching of depth-rotated novel objects is easier when the objects differ in a NAP than an MP. (Equal performance at 0 deg because physical differences of MPs > NAPs.)

Sample stimuli:

Pathologies:

- Expansion versus no expansion of the cross-section of the cross-section of the cross-section
- Positive curvature of the sides versus straight sides of the sides
- Curved main axis versus straight main axis of the main axis

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