Perception of global form modulates motion responses in human early visual cortex

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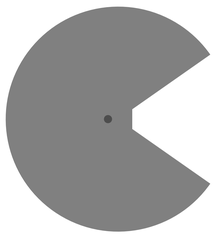
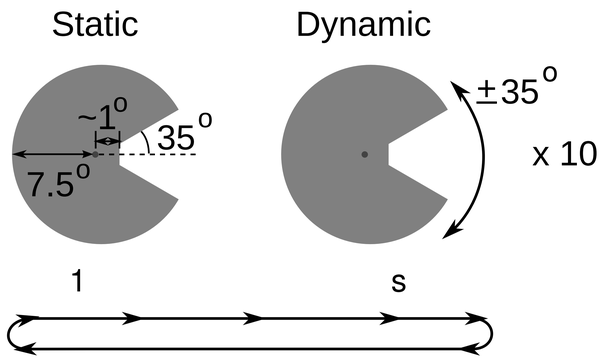


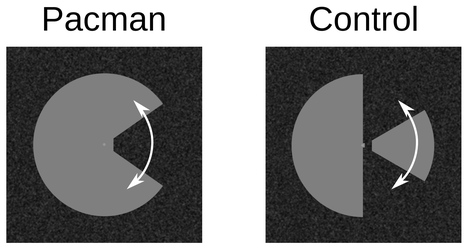
When this "pacman" oscillates with a small amplitude about the axis perpendicular to its center, the physical changes in the image are limited to the right visual field. Yet, human observers perceive the entire object as oscillating, including the stationary portion in the left visual field.

Here, we investigate whether this perceptual grouping-dependent implied local motion perception is reflected in cortical activity. Particularly, we are interested to find out whether there is neuronal activity in the right hemispheres of participants' brains, which process the the left visual field.

Methods

Scanner: Siemens 3T Magnetom trio
Participants: Three participants, all Bilkent undergraduate students
BOLD sequence: TR=2s; TE=40ms; flip angle=71 deg.; 26 slices parallel to CS; slice thickness=3mm; in-plane resolution=3x3mm

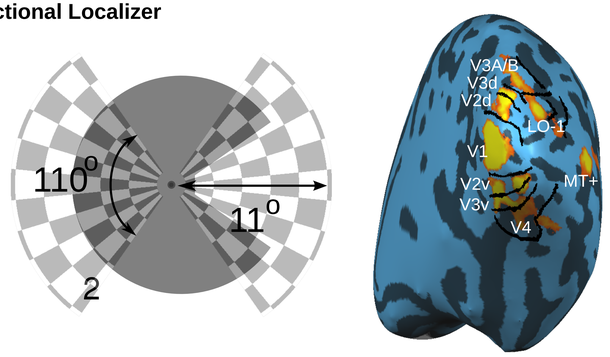




Control condition: The wedge in the control condition oscillates about the axis perpendicular to the fixation mark. This leads to no implied localized motion on the left semi-disk, even though the dynamic features on the right visual field carry identical energy as in the Pacman condition

Attention task: Fixation mark changed luminance every 1750-2250ms for 200ms (darker or brighter). Participants' task was to indicate the direction of the change. (overall success rate: 91%; mean reaction time:644ms)

Functional Localizer

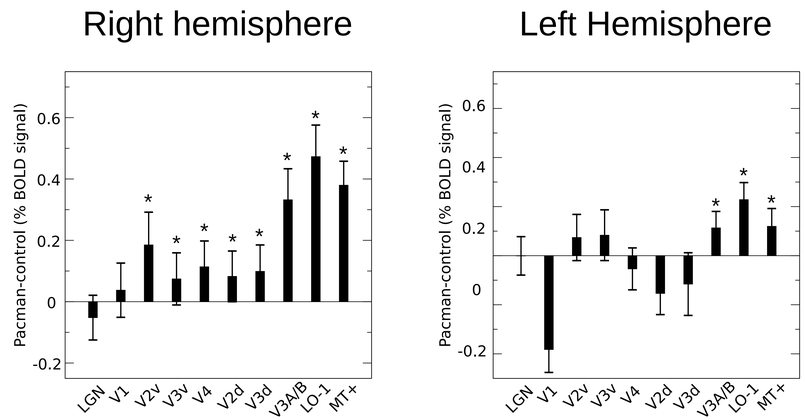


Analysis and results

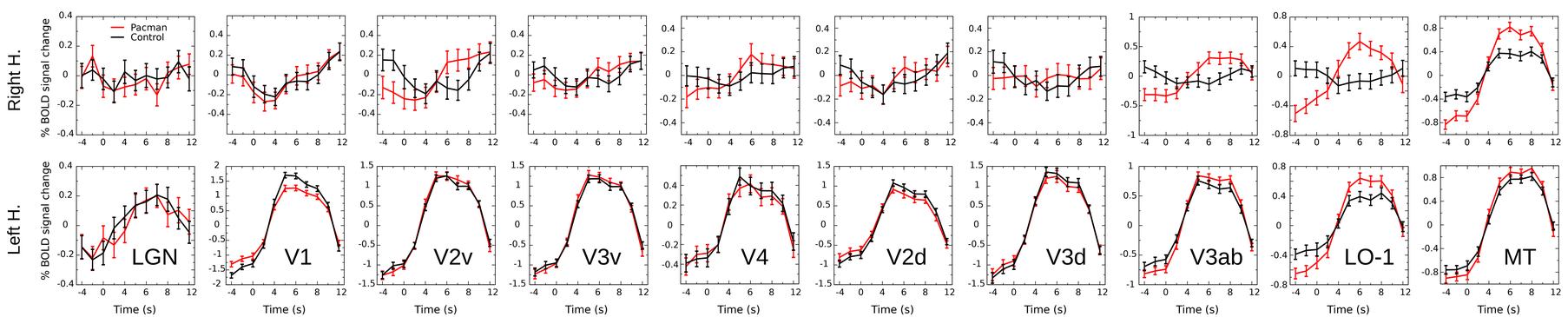
Preprocessing steps: Motion correction, high pass filtering, linear trend removal, coregistration of structural with functional data

Analysis steps:

* Extract the time course of BOLD signal from the fROI in each visual area
* Compute % BOLD signal change in each run using the scan mean
* Compute the averaged signal for each epoch (static, dynamic)
* Compute at each time point the difference between dynamic and static conditions
* Compute the difference between the Pacman and control conditions in each time point
* Compute the mean difference from the 8th through 12th second



Fixed effect analysis; Error bars: 95% confidence interval;
*: p<0.05 (one-tailed independent one-sample t-test)



Discussions:

* We found that cortical activity correlates with the perceived local motion even in the absence of any physical motion in all areas except LGN and V1
* The perceptual grouping leads to inter-hemispheric interactions; consistent with literature [1], except in V1
* Effect order: LO-1 > MT+ > V3A/B > V2v >...> V1 > LGN; this is largely consistent with previously identified cortical activity patterns in response to physical motion [2].

References:

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2. Tootell, Mendola, Hadjikhani, Ledden, Liu, Reppas, Sereno, and Dale, "Functional analysis of V3A and related areas in human visual cortex," J. Neurosci., 1997.

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