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Lessons from the primate visual system

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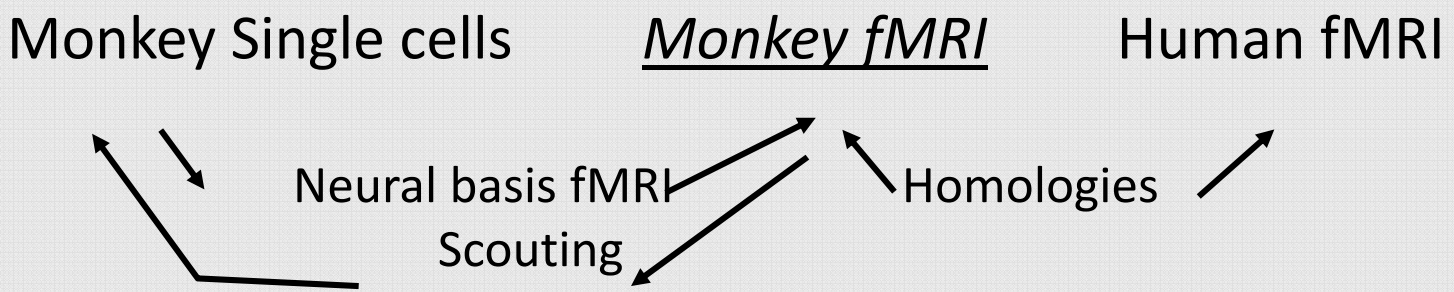
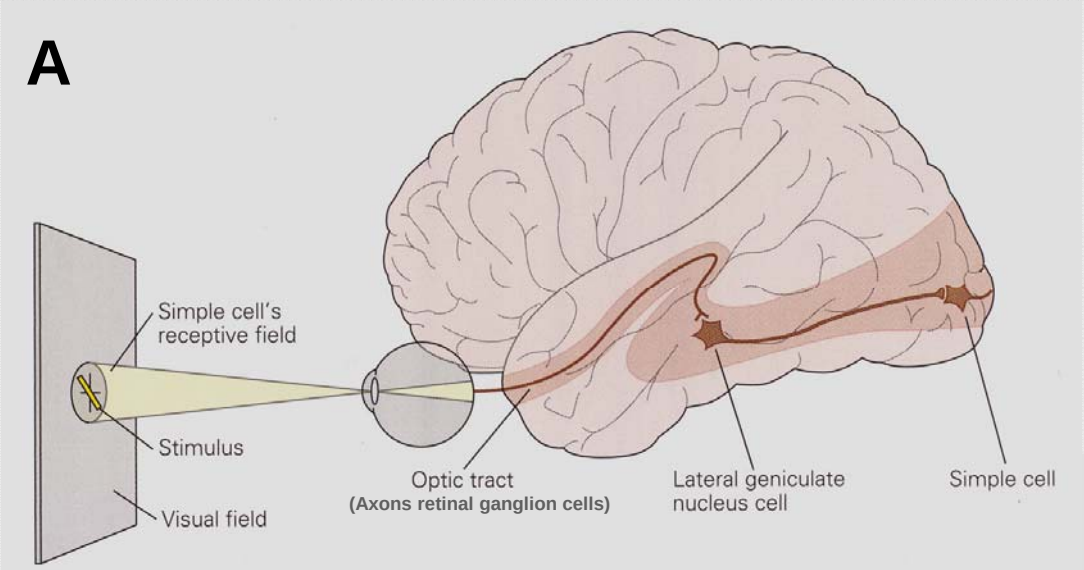
Collaboration: R Vogels, S Mysore, D Xiao, W Vanduffel, O Joly, JB Durand, K Nelissen, R Peeters, J Jastorff, R Abdollahi, J Todd

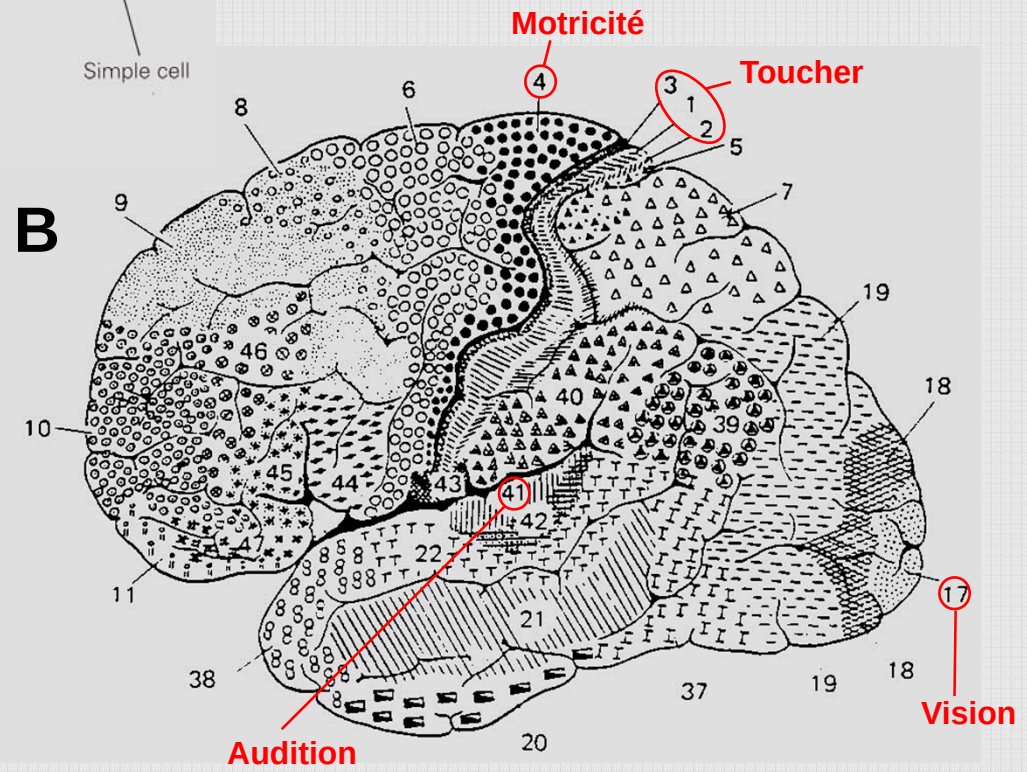


Monkey needs to be awake

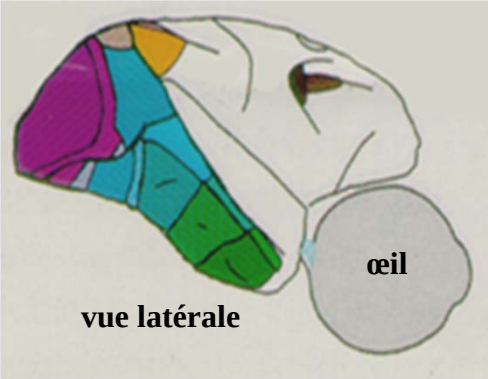
Monkey fMRI double purpose:
guiding single cell studies
Link with human imaging

Voie rétino-géniculo-striée et parcellation de Brodmann



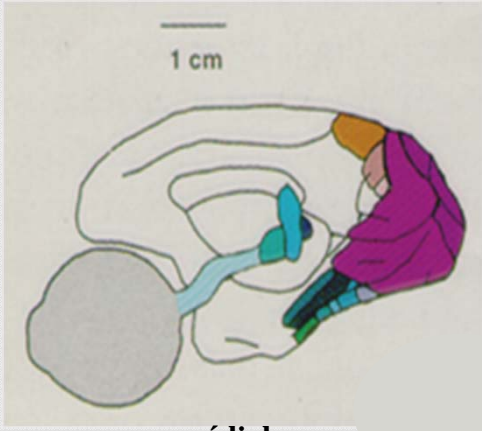


Cerveau de primate non humain : Macacca Mulatta

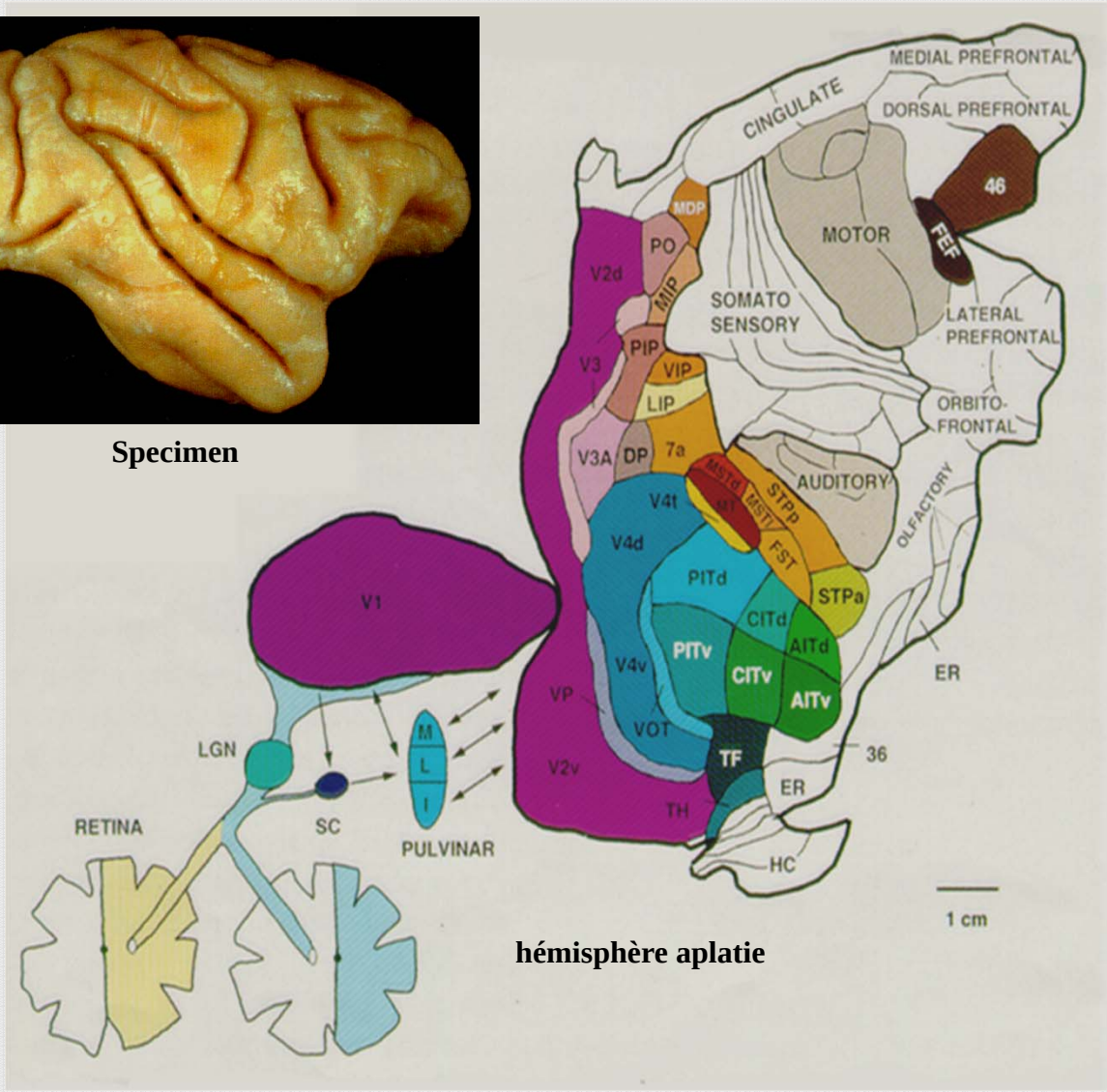


vue latérale

Specimen

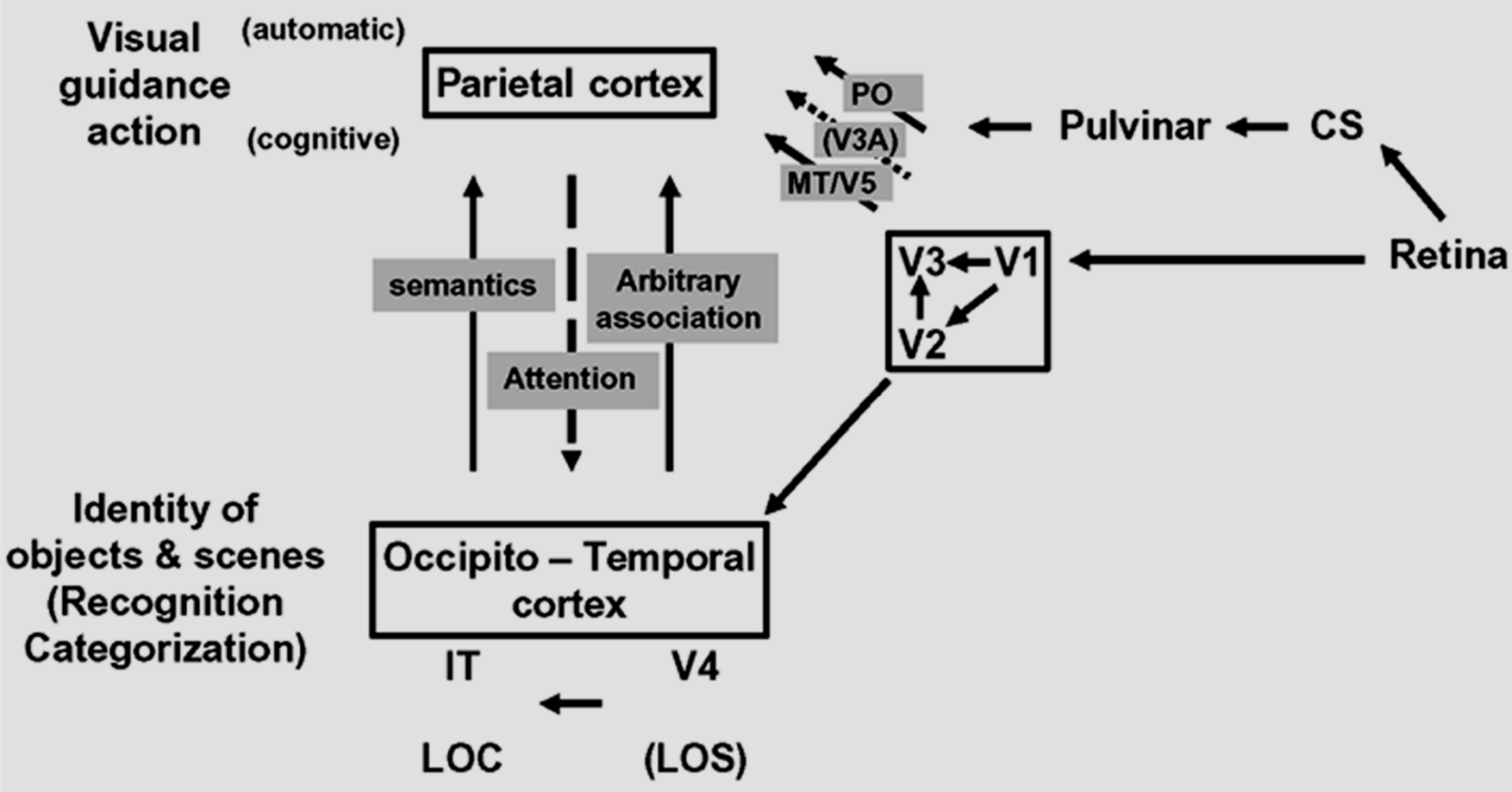


vue médiale

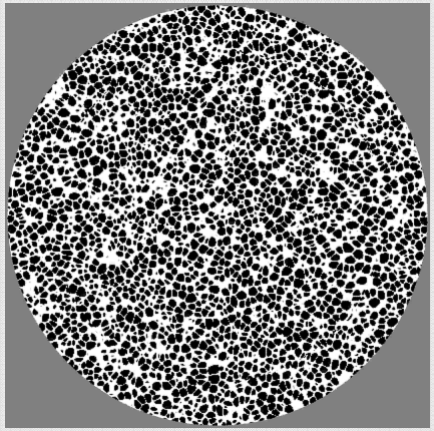


hémisphère aplatie

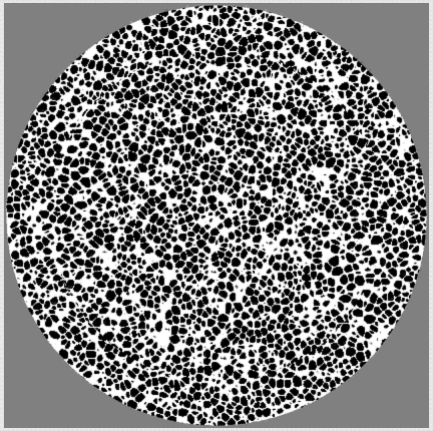
Dorsal and ventral visual streams



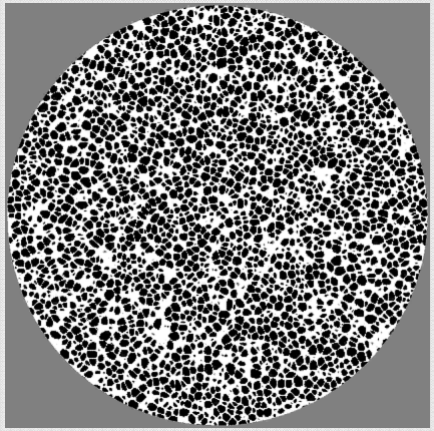
Tests pour les neurones FST



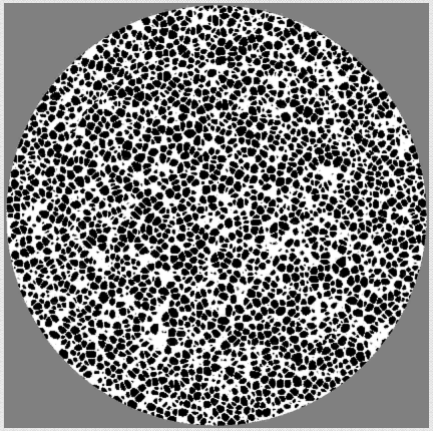
Premier Ordre: surface inclinée
(8 orientations)



Second ordre: surface cylindrique
(4 orientations)



Second ordre: bosse

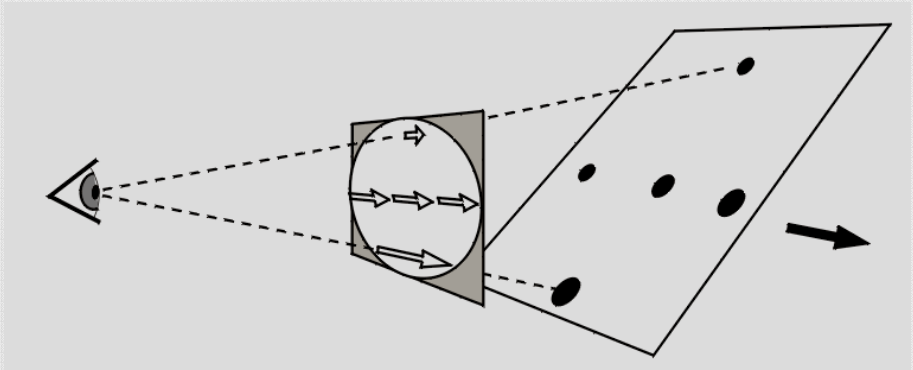


Second ordre: selle
(2 orientations)

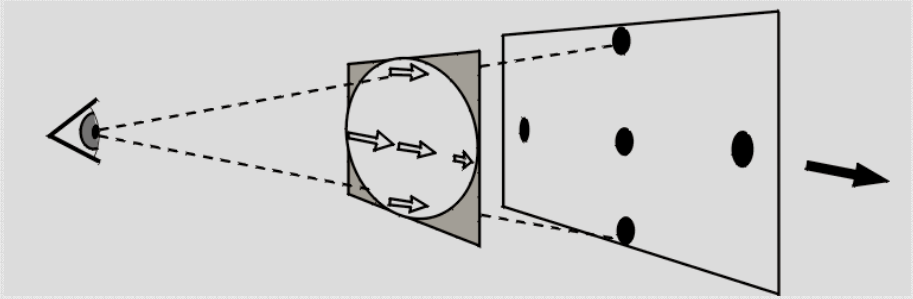
MT/V5 neuron selective for direction of the speed gradient, corresponding to tilt direction

A

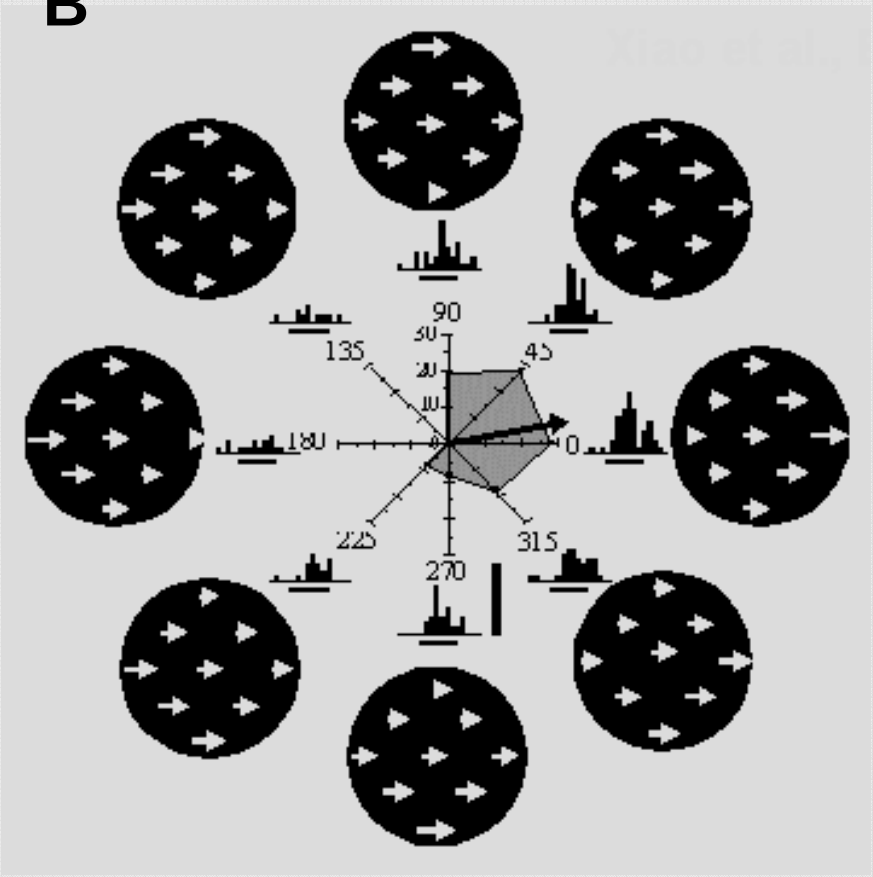
Vertical Gradient



Horizontal Gradient

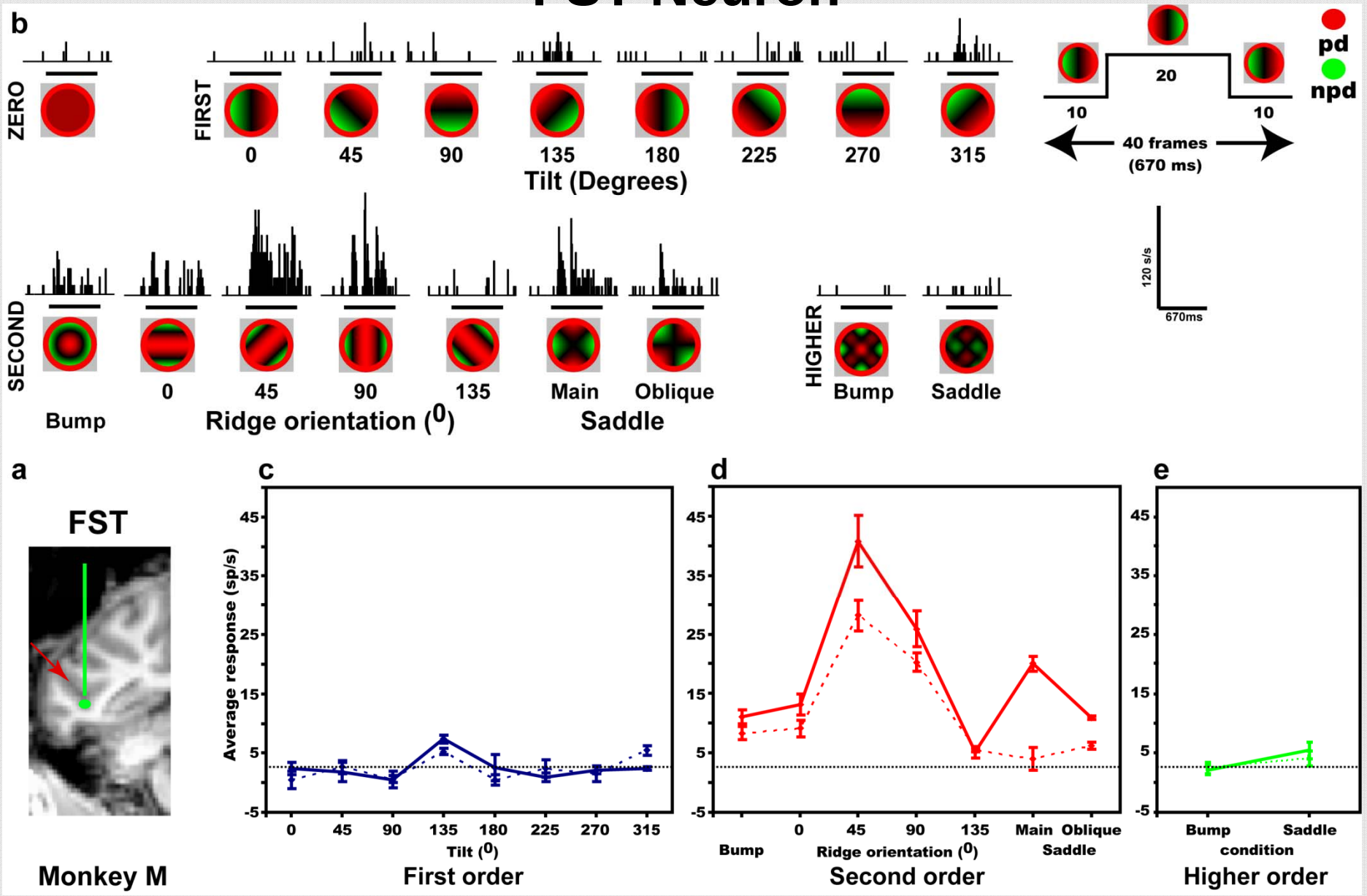


B



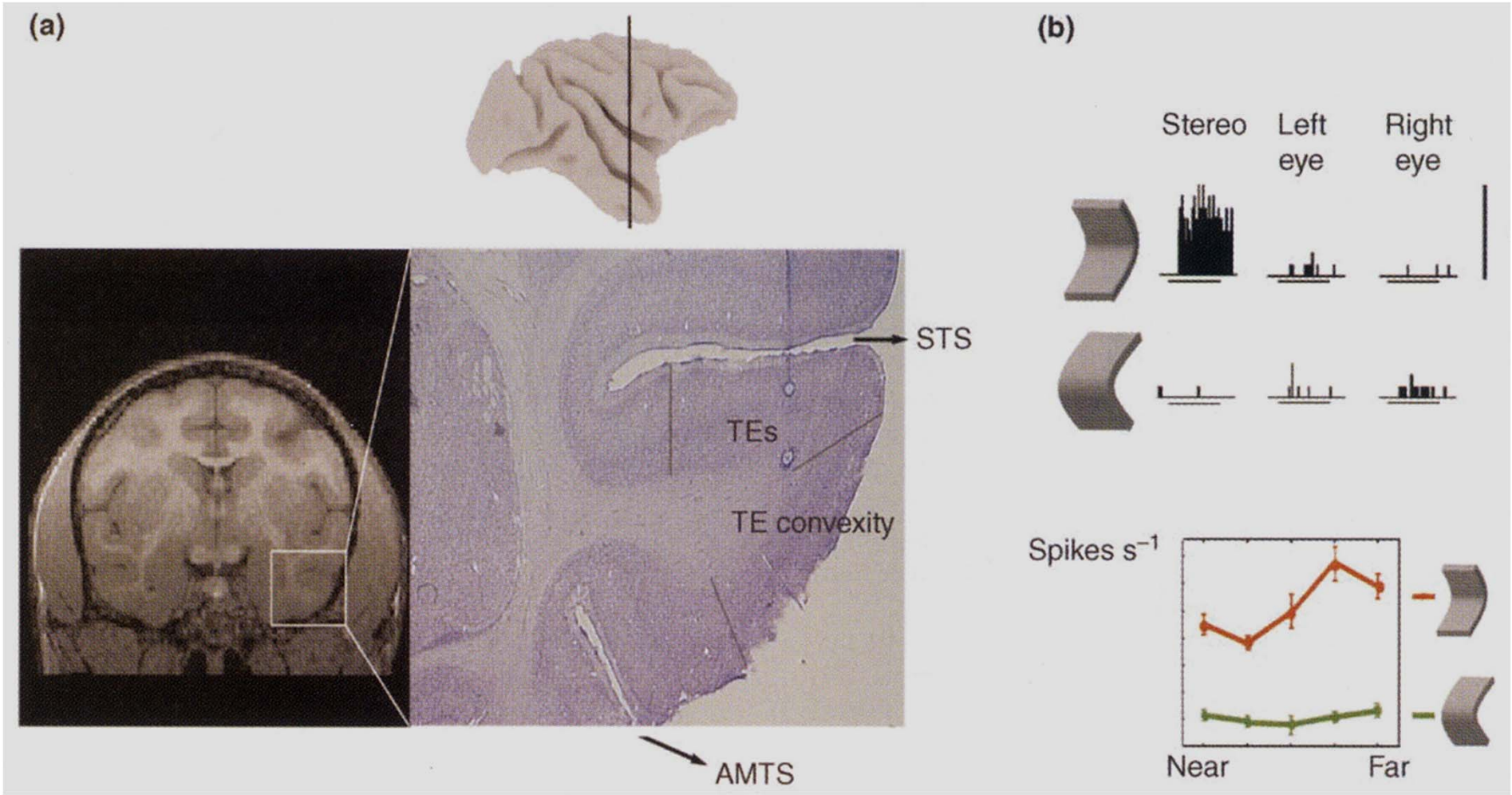
D.K. Xiao et al, Eur. J. of Neurosci., ´97

FST Neuron

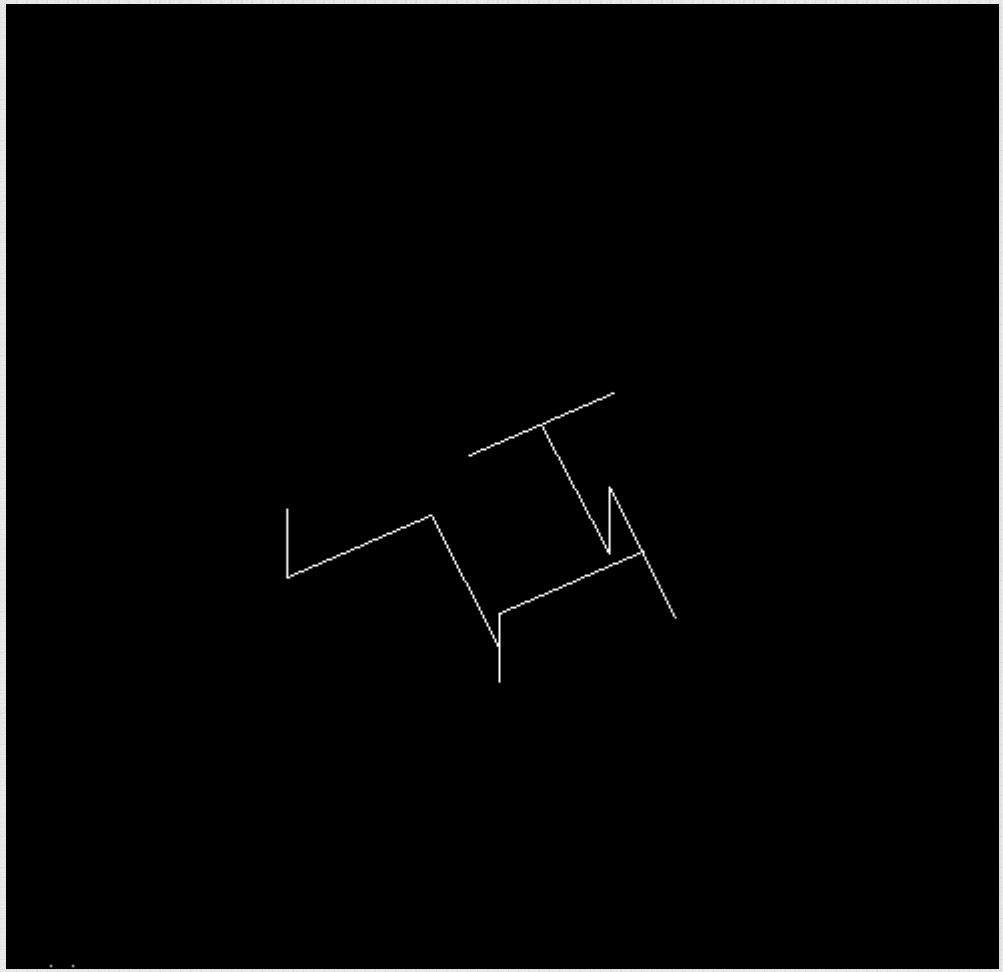


Md182_F

TEs: HIGHER ORDER DISPARITY SELECTIVITY

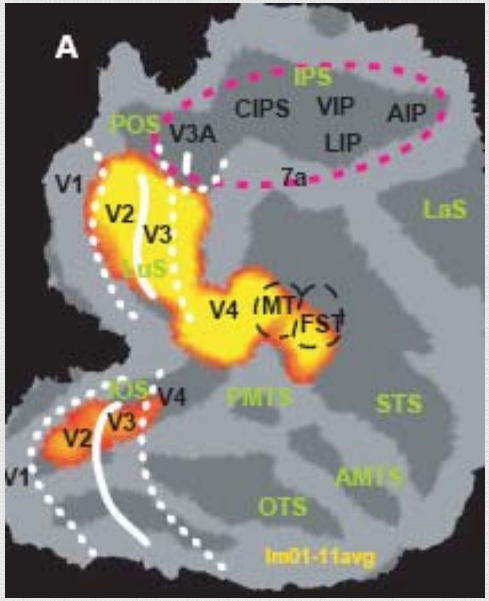


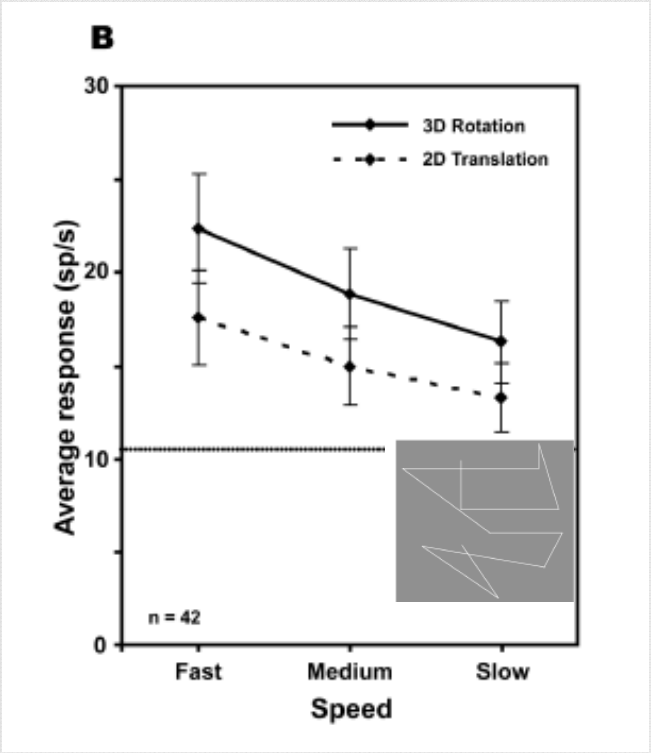
Janssen et al Science 2000 Orban et al TINs 2006

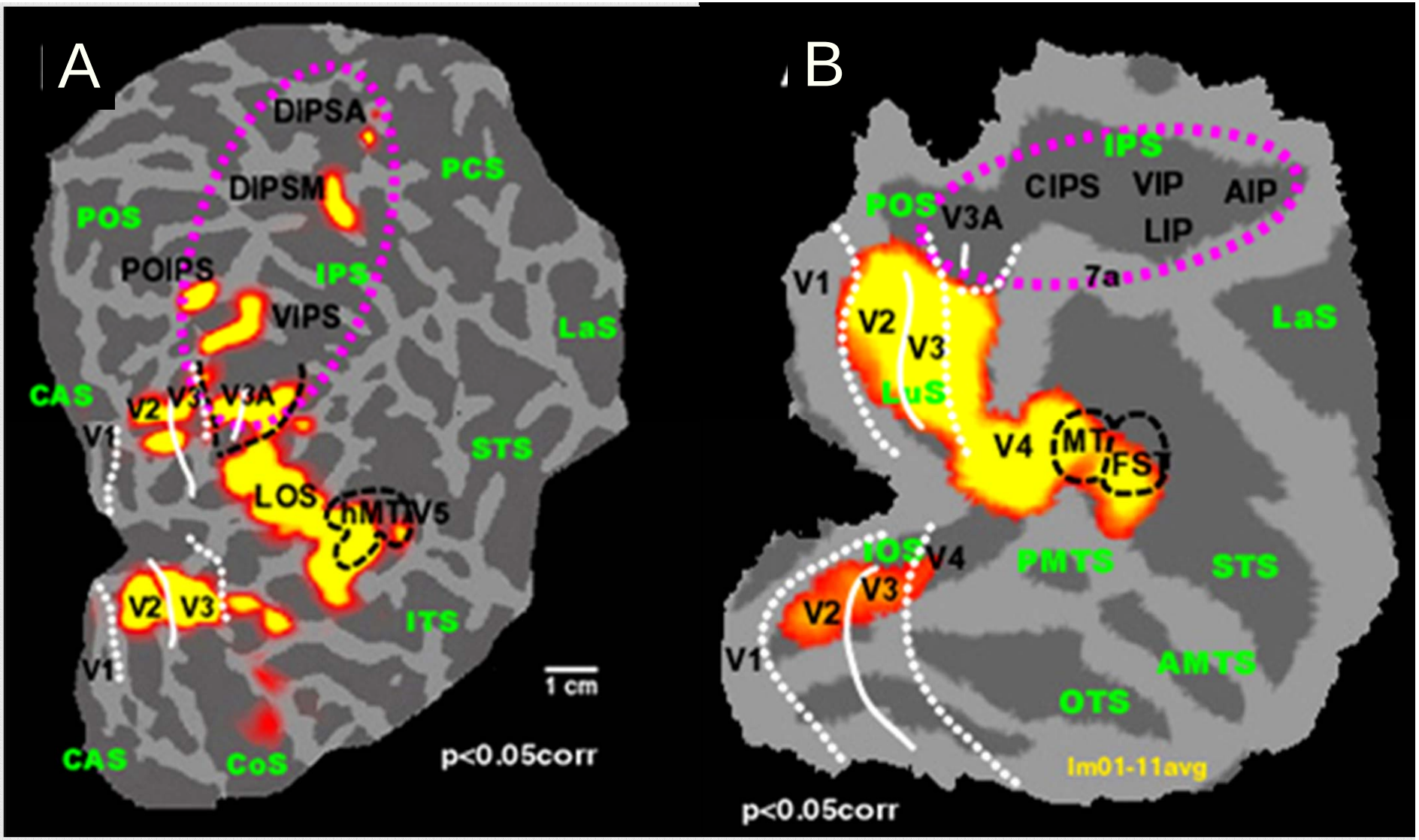


RANDOM LINES

Comparison fMRI Single neurons







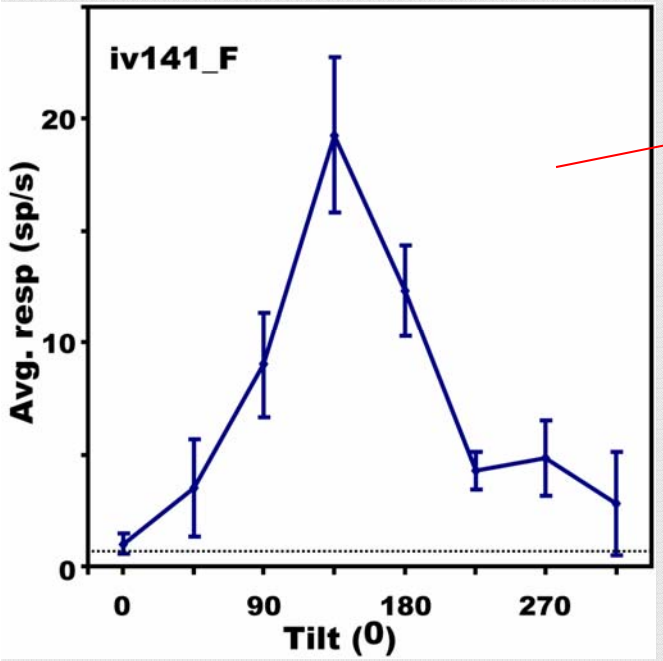
Human

Monkey

Vanduffel et al Science 2002

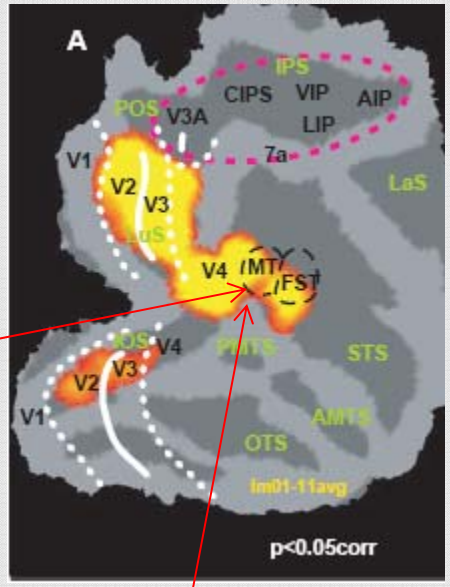
Depth structure from motion

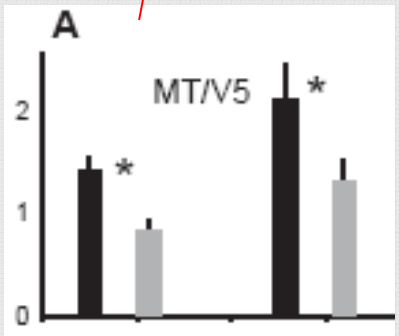
MT/V5 Neurons



Tilt corresponds to direction of linear speed gradient

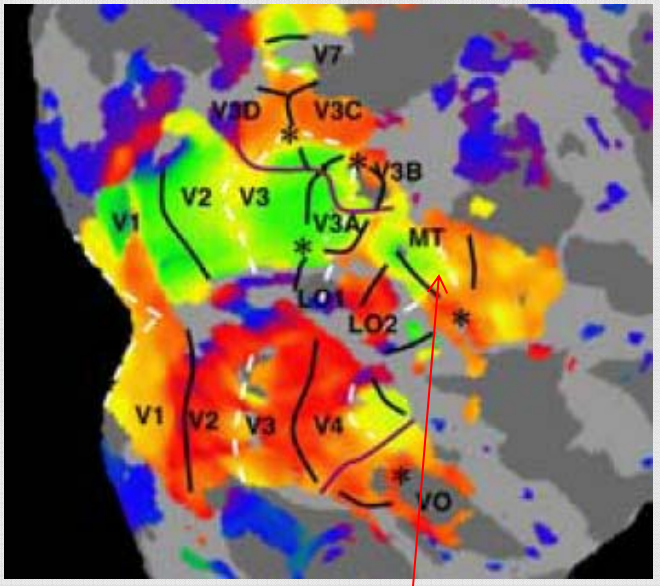
MT/V5 MR signals

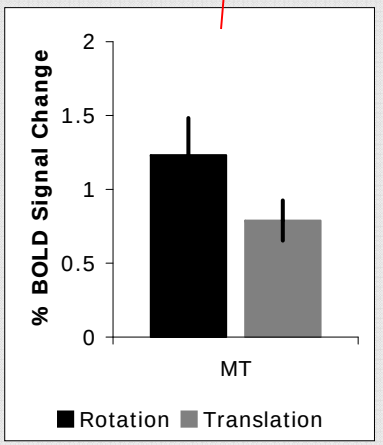




MR signal for 3D shape condition (black) and 2D control (grey)

human MT/V5 MR signals

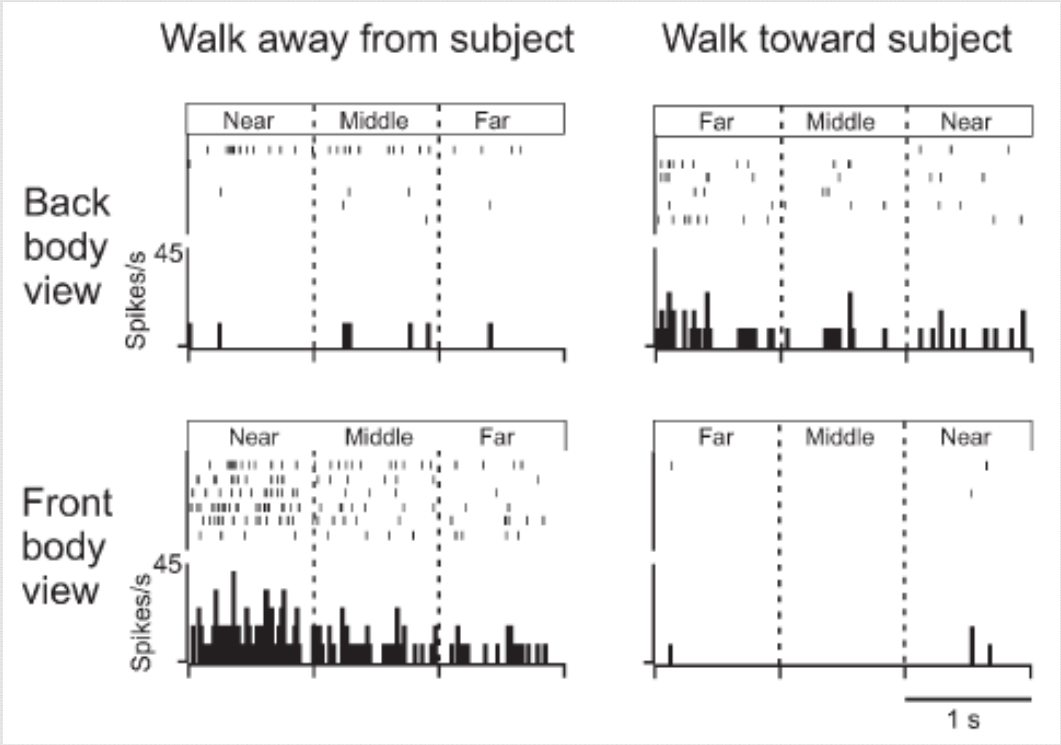




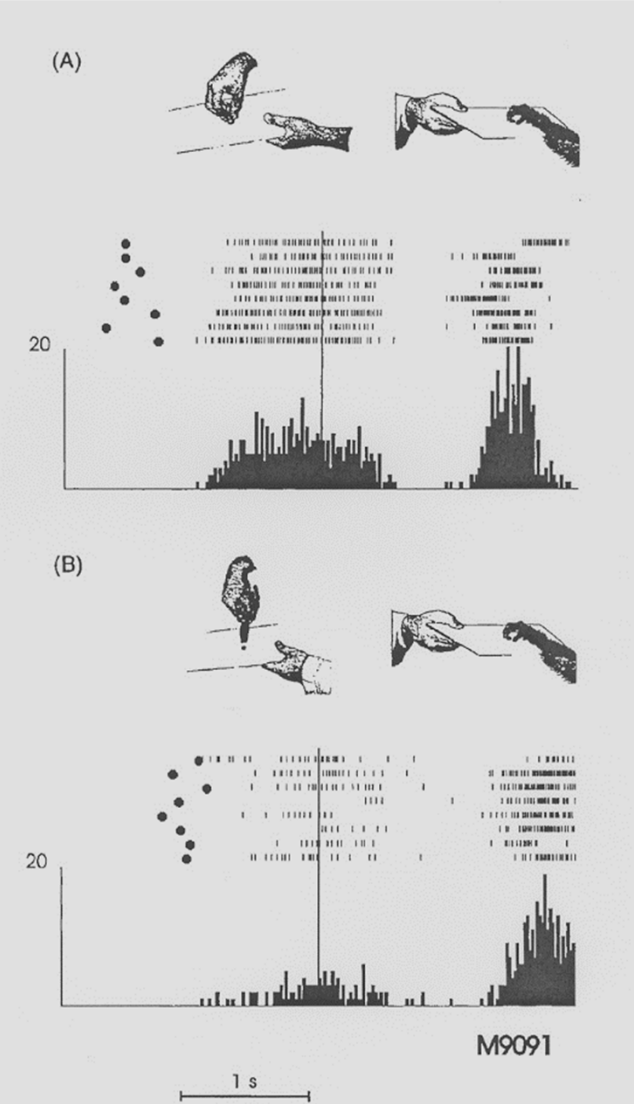
ACTION HAND

Action responsive neurons

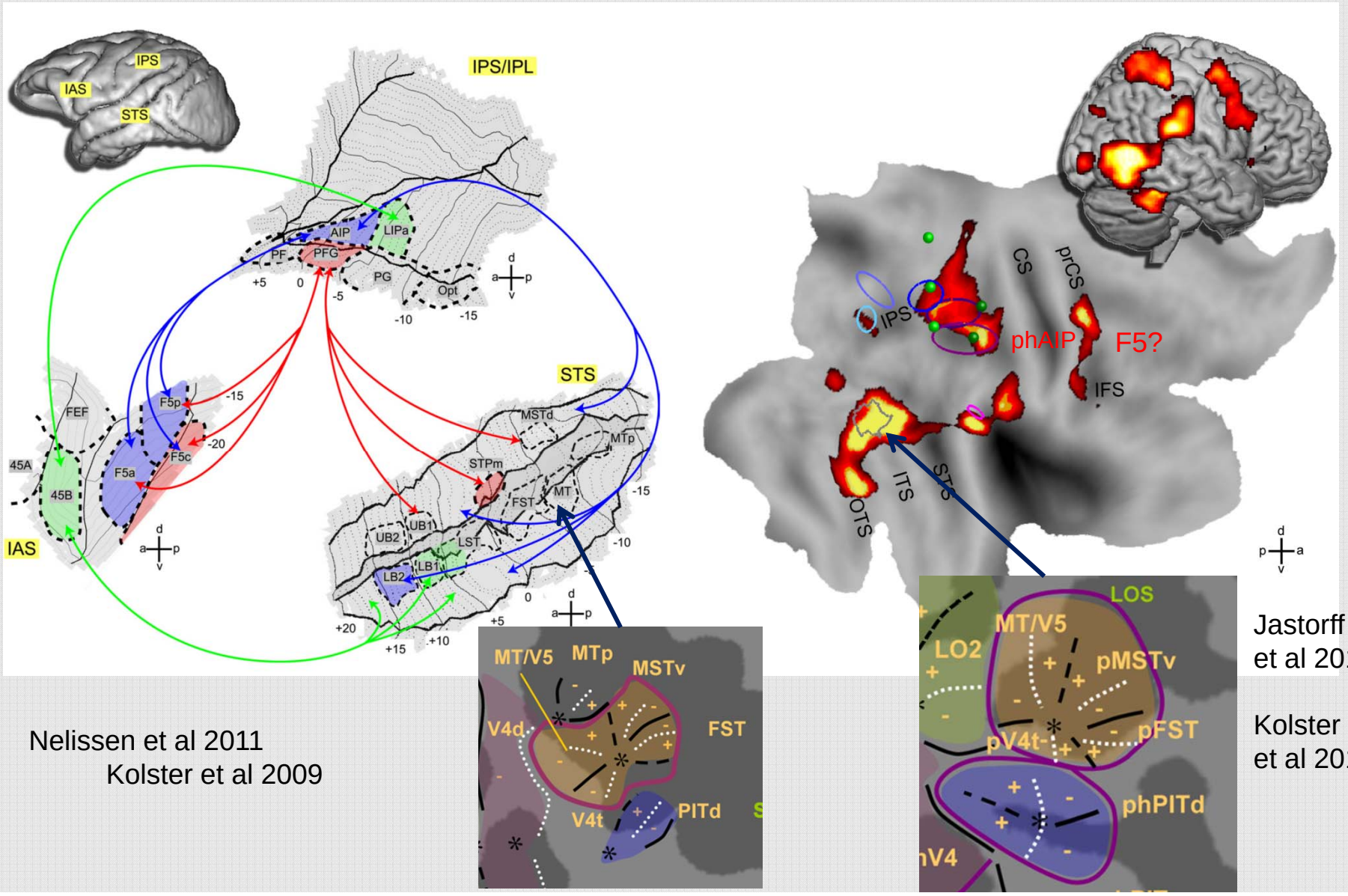
STS: Jellema et al 2004



Ventral premotor cortex (F5)



The biological action observation circuit

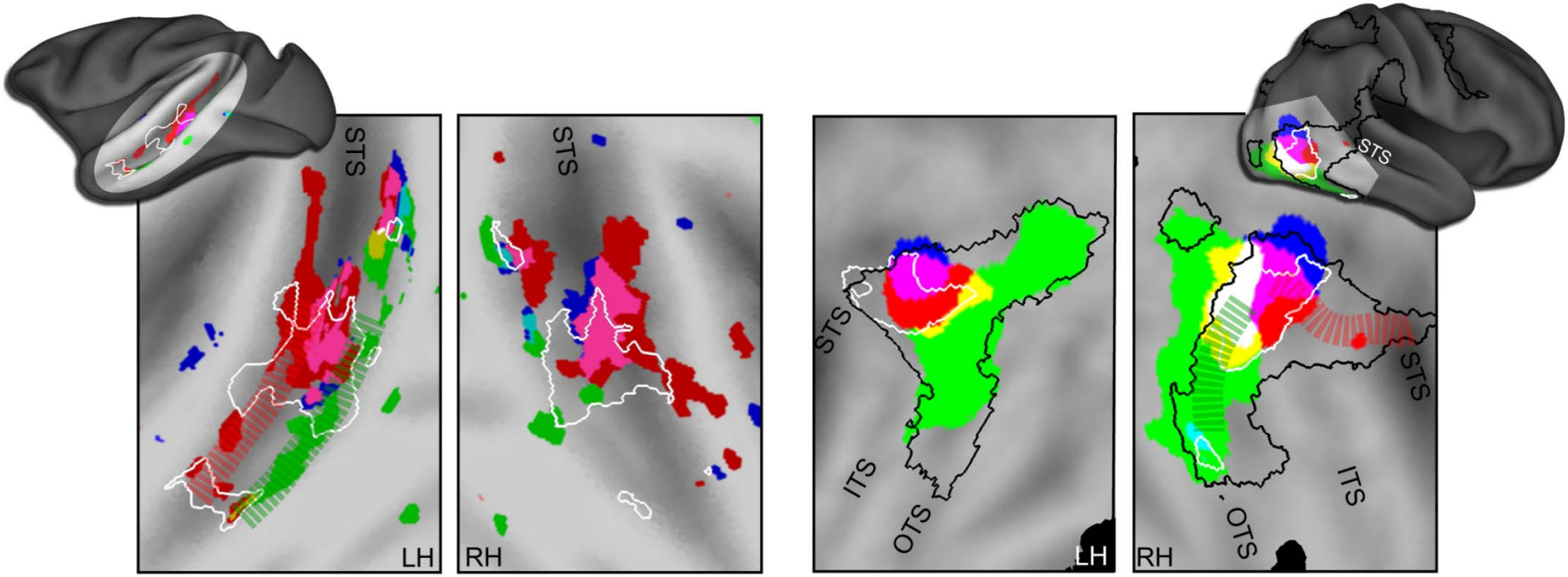


Nelissen et al 2011
Kolster et al 2009

Jastorff et al 2010

Kolster et al 2010

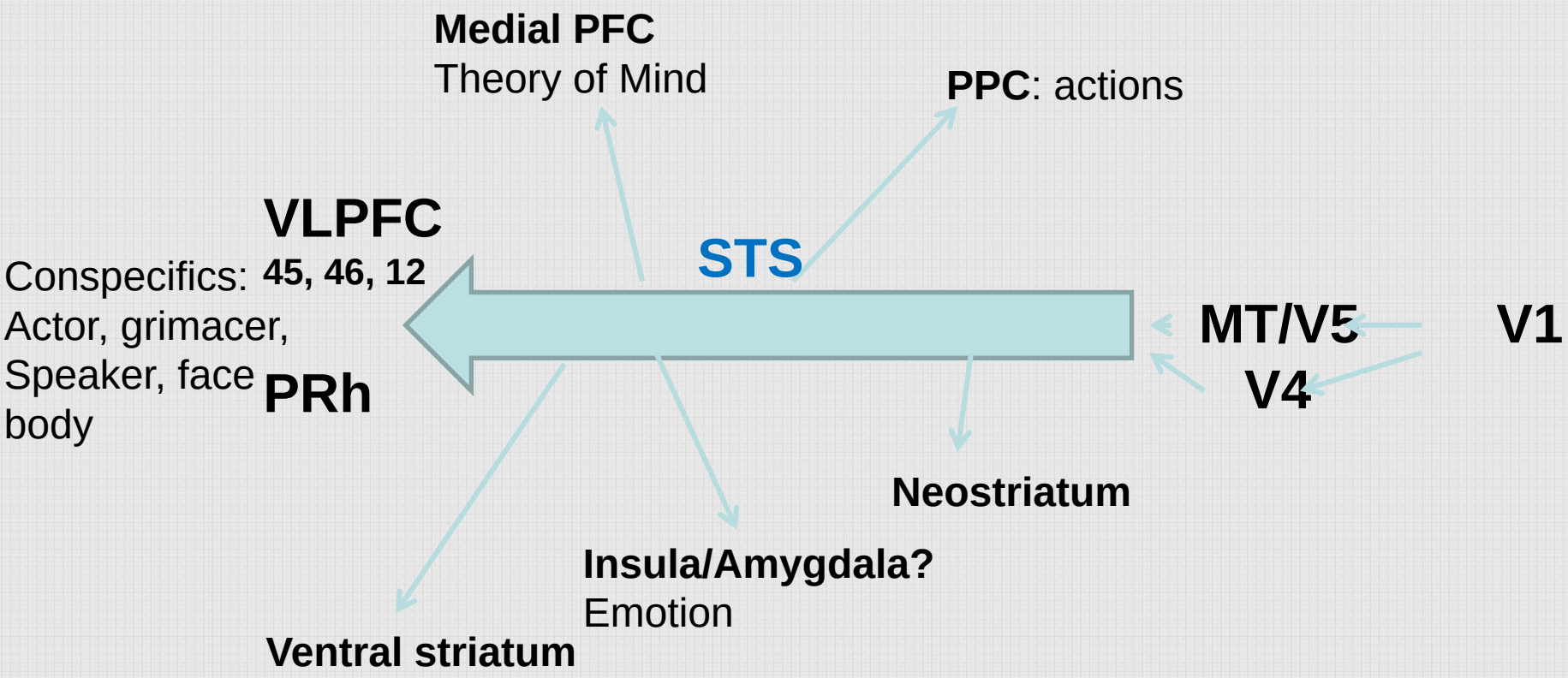
IA: Homology of monkey STS



Jastorff et al Neuroimage 2012

Jastorff & Orban J Neurosci 2009

STS connections/function

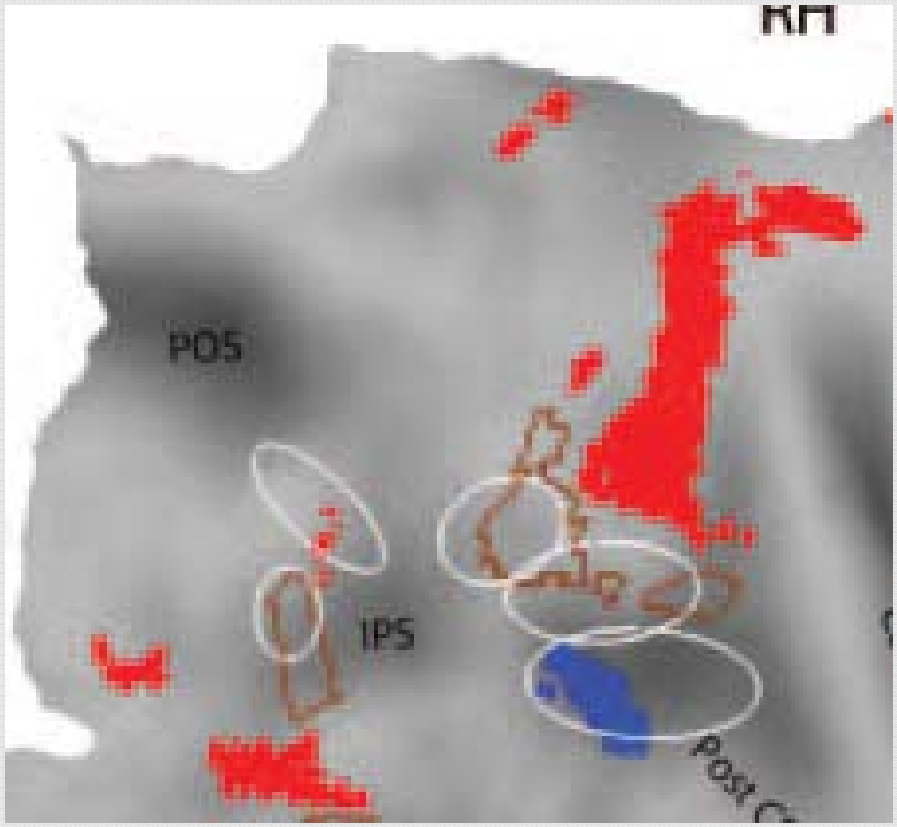


Orban in preparation

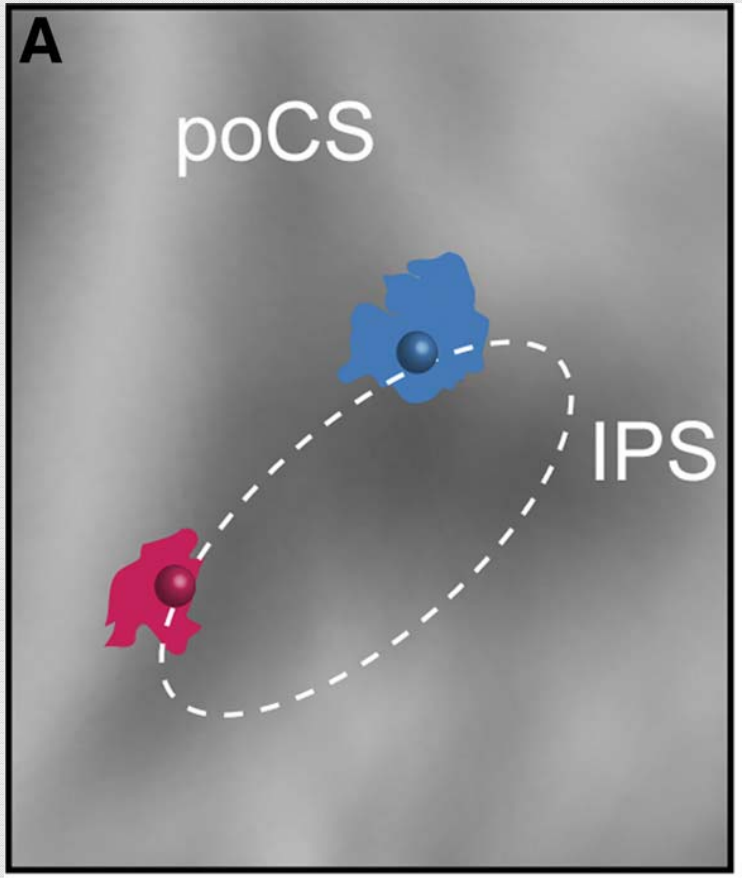
Parietal cortex: effect of type of action

PPC segregation regions involved in different classes of action (Manipulation, Climbing)

AIP: segregation positive and negative manipulative actions

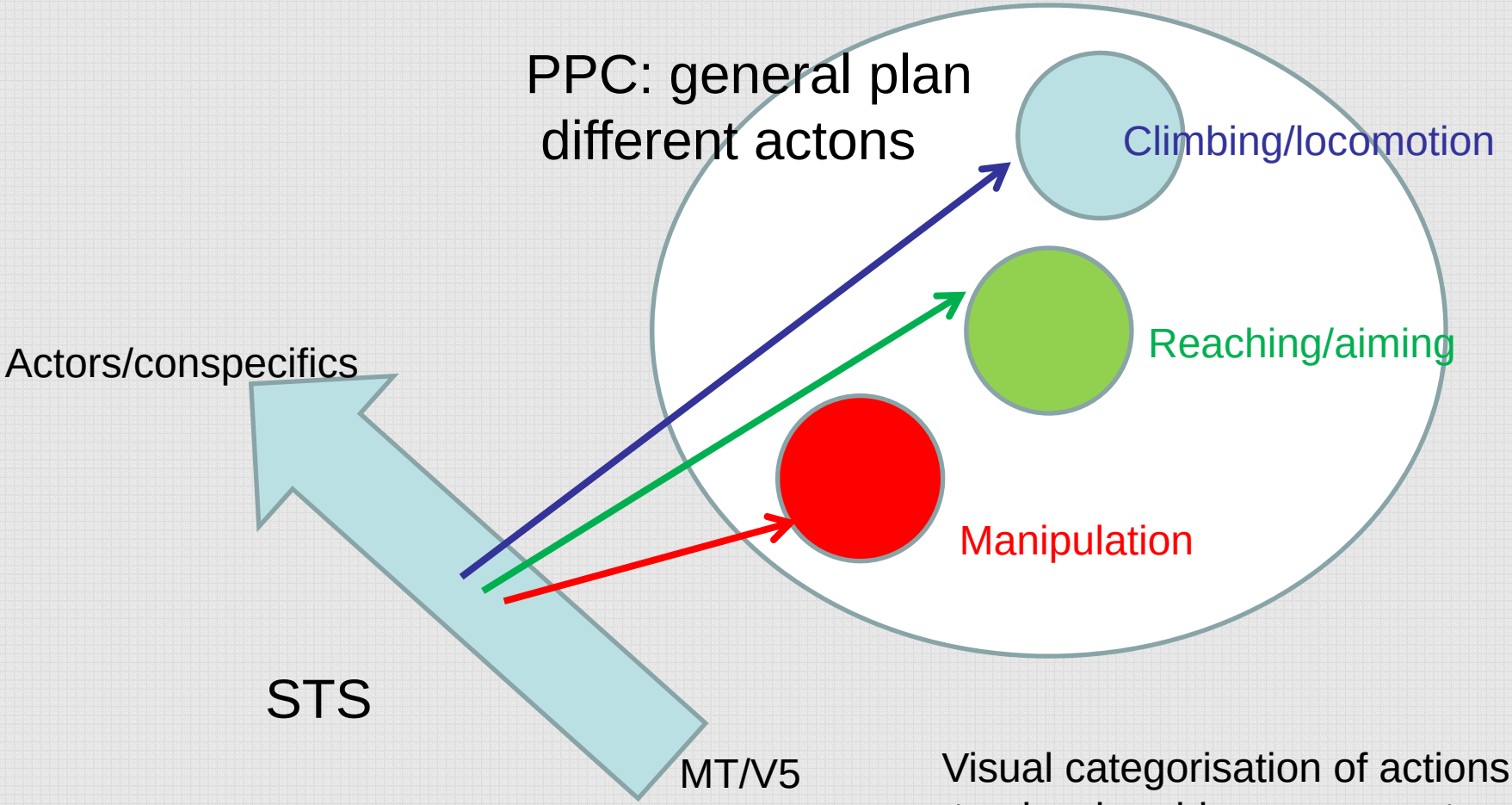


Abdollahi et al Cerebr Cort 2012



Jastorff et al J Neurophysiol 2010

Hypothetical scheme PPC



Visual categorisation of actions
too hard problem: many actors
many poses, many viewpoints:
solution map onto motor plan

Orban in prepartion

Conclusions

1) depth structure is processed in both dorsal (3 cues) and ventral (all four cues) pathway

2) processing of individual cues is more restricted in the ventral pathway (only posterior parts, but see Yamane et al 2008)

3) monkey system is simpler than human counterpart: new areas and new properties in humans

4) underlying neuronal mechanism disparity, motion and texture cues: first and second order gradient selective neurons

5) Shading cue: gradient but with need luminance direction