# Understanding the human brain requires appropriate animal models:

**Guy Orban**
**(KU Leuven and Universita di Parma)**

Human brain is still difficult to study: fMRI is an indirect technique, making assumptions which are not always verified: repetition suppression, multivoxels pattern analysis

Direct electrical exploration is limited (regionally, mostly lfps)

# Understanding the human brain requires monkey studies

The monkey is by far the best animal model:

- Anatomically: Monkey cortex= 1/10th of human cortex (scaling up is possible); that of a mouse =1/1000 ( no scaling up, most cortical areas are missing)
- Genetically: human transcriptome is radically different from that of the mouse because of the large proportion of human-specific micro RNAs
- Behaviorally:

  monkey has the same visual psychophysical performance as humans, the mouse not

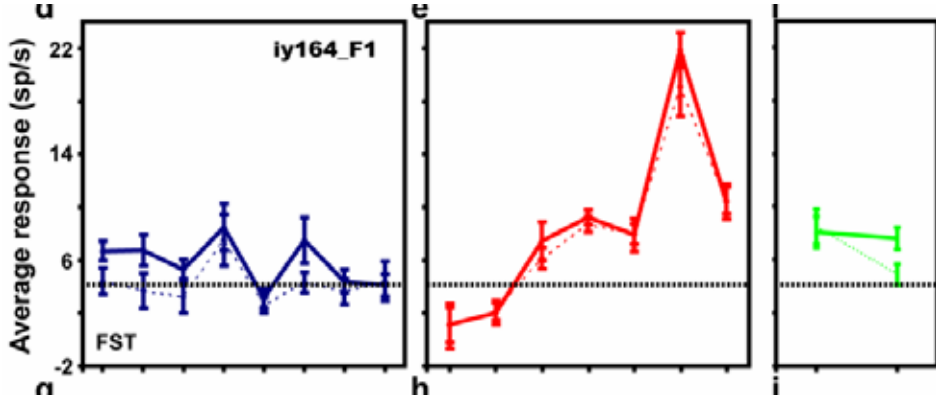
  monkey has same spatial attention and saccades as humans, the mouse not

# Understanding the human brain requires monkey studies

- Monkey investigation is making huge progress due to fMRI in the awake monkey

1) fMRI is used as a scouting tool: new neuronal properties are readily discovered: eg

speed gradient selective neurons in FST (Leuven)



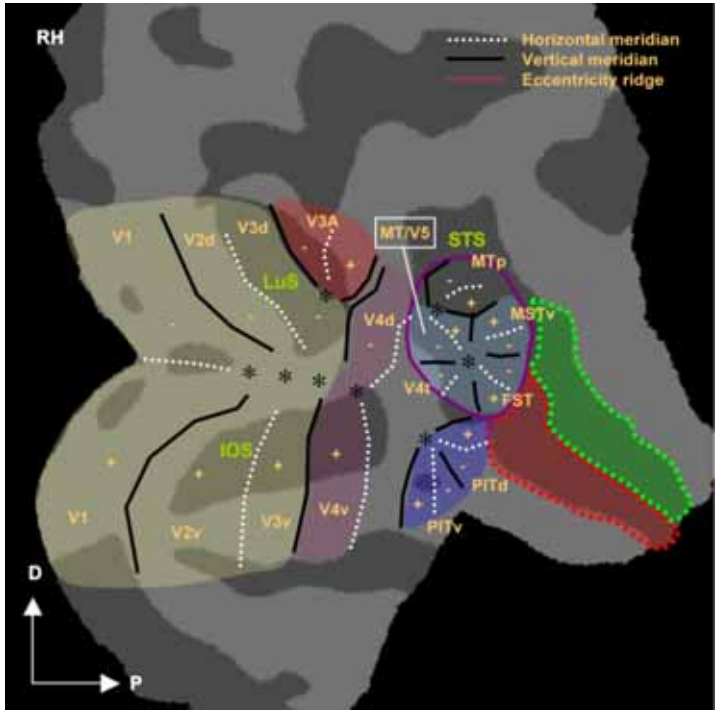

miror neurons in AIP (Parma)

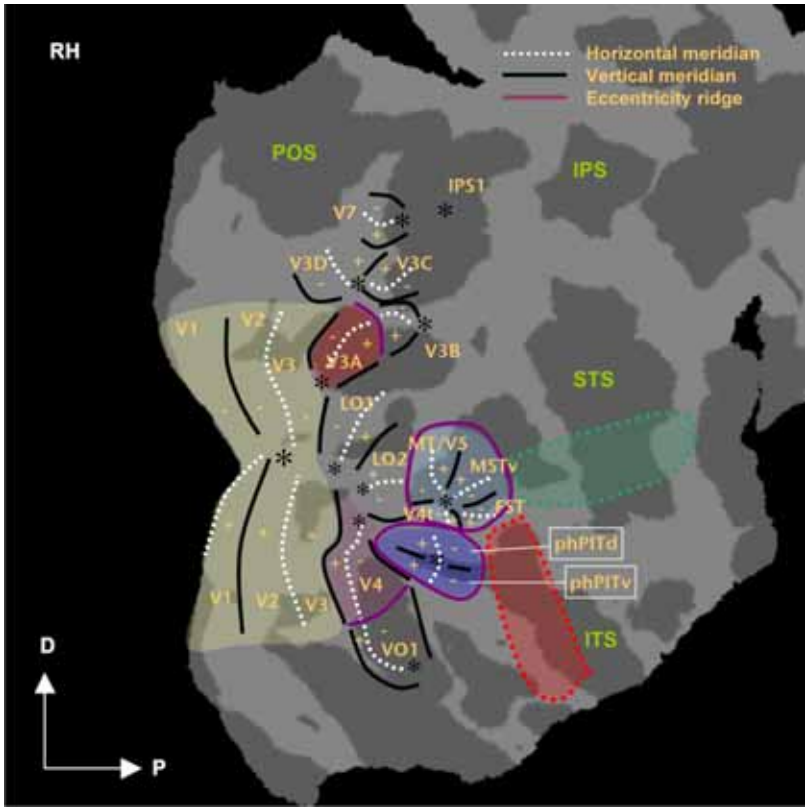
face selective neurons in face patches (Tsao)

Mysore et al in rev

# Understanding the human brain requires monkey studies

- 2) Monkey fMRI with human fMRI establishes homology between human and non human primate cortical areas



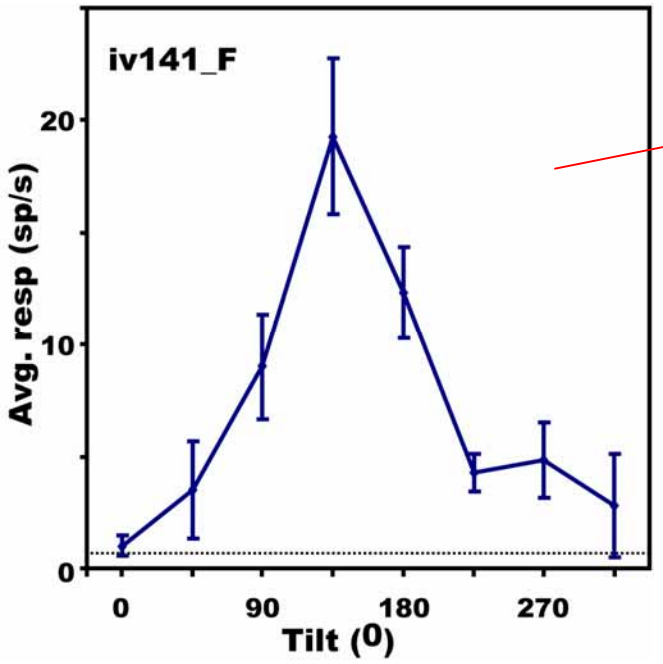




Kolster et al J Neurosci in press

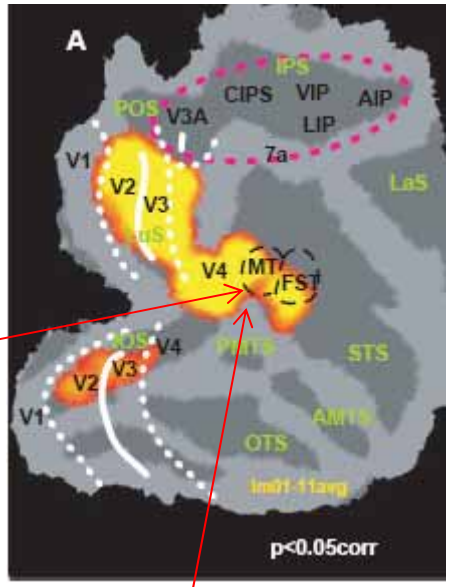
# Understanding the human brain requires monkey studies:

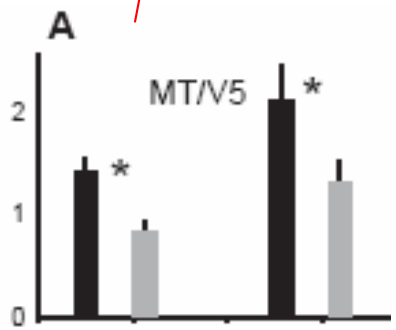
## 3) monkey fMRI: imaging with same paradigm in both species

MT/V5 Neurons | MT/V5 MR signals | human MT/V5 MR signals

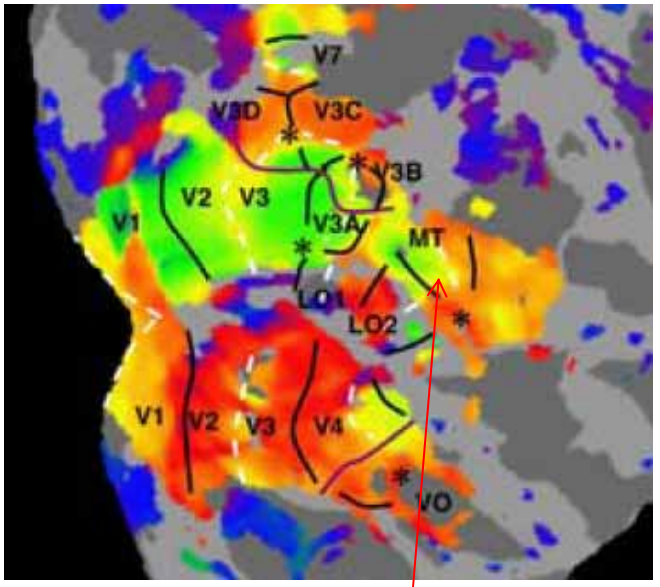


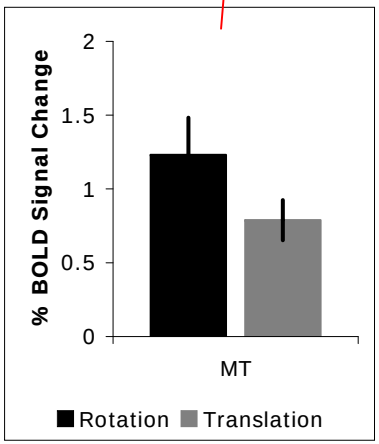

Tilt corresponds to direction of linear speed gradient




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

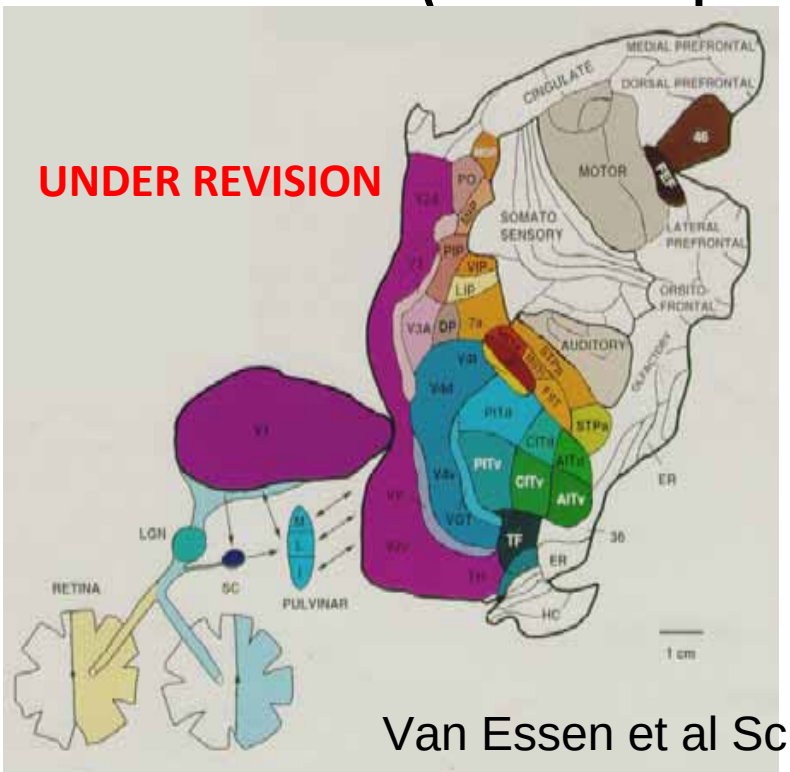



Mysore et al
In rev
Vanduffel et al
Science 2002
Kolster et al
J Neurosci
in press

# Understanding the human brain requires monkey studies

- We know the basics of cortical function: cortical areas transitorily cohere with others to constitute a network that underlies the task at hand (task dependence).




Van Essen et al Science 1992

During Visual search FEF and V4 cohere, first FEF spikes synchronize with V4 lfps, then the synchronization reverses. (Gregouriou et al Science 2009)

We ( Europe) have a strong interest in inter-area synchronization: P Fries new MPI in Frankfurt

# Understanding the human brain requires monkey studies

- Intermediate goals can be defined:

Understanding of the visual processing of others' actions can be solved in the next 5-8 years:

Has a lot of medical interest: diseases affecting social interactions

Has many potential industrial applications in surveillance and in video games

We know where it happens: in the depth of the Superior temporal sulcus (and connections ): Leuven-Parma collaboration.

We have a bottom up strategy: predict selectivity of higher order neurons from those of lower order neurons we know already.

We have also a top down approach: predict neuronal properties from imaging experiments.