

# *LES RESEAUX CORTICAUX VISUELS : L'APPORT DE L'IRM FONCTIONNELLE*

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Chaire européenne 2006-2007

Cours 3

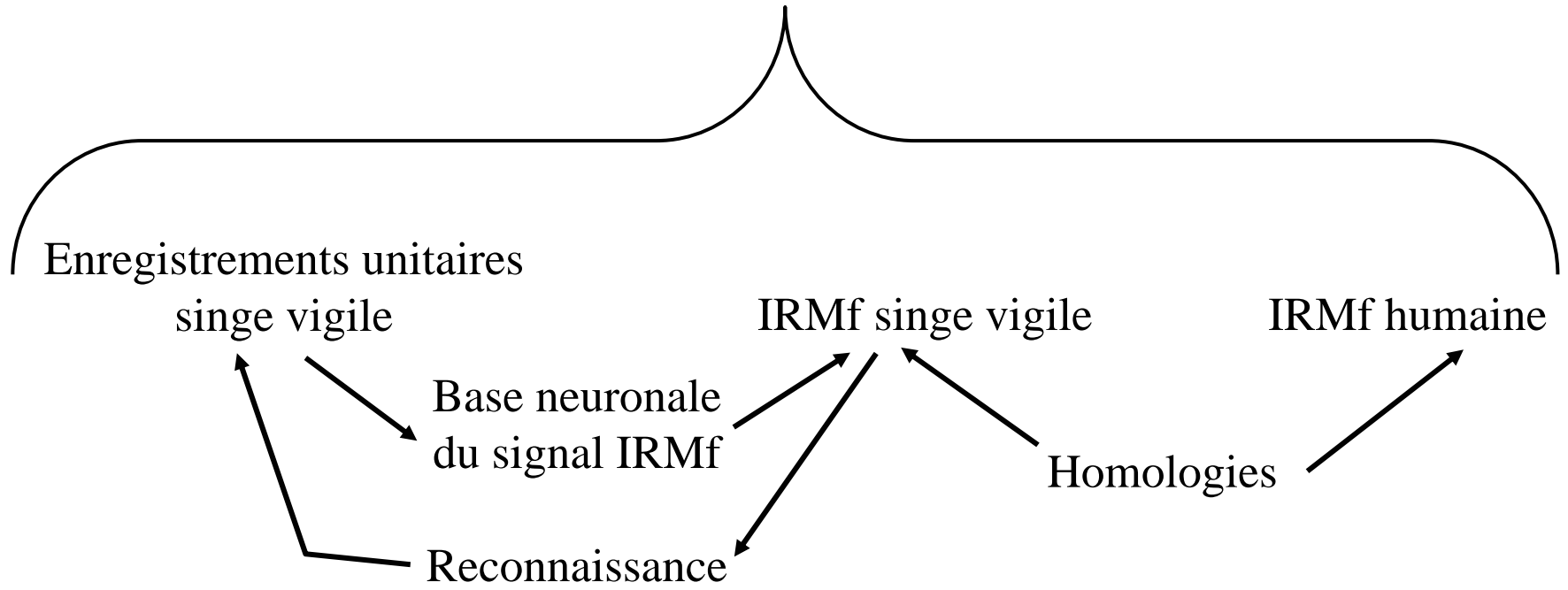


COLLÈGE  
DE FRANCE  
— 1530 —

KATHOLIEKE UNIVERSITEIT  
**LEUVEN**



Cerveau = Circuits + Molécules



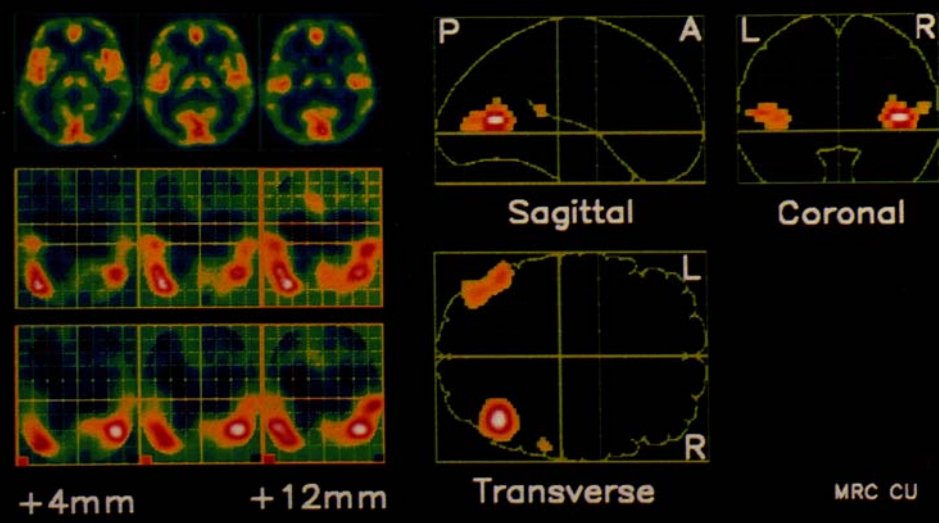
## **Imagerie par Résonance Magnétique fonctionnelle (IRMf)**

**Avantage:** technique non invasive, donc applicable à l'homme

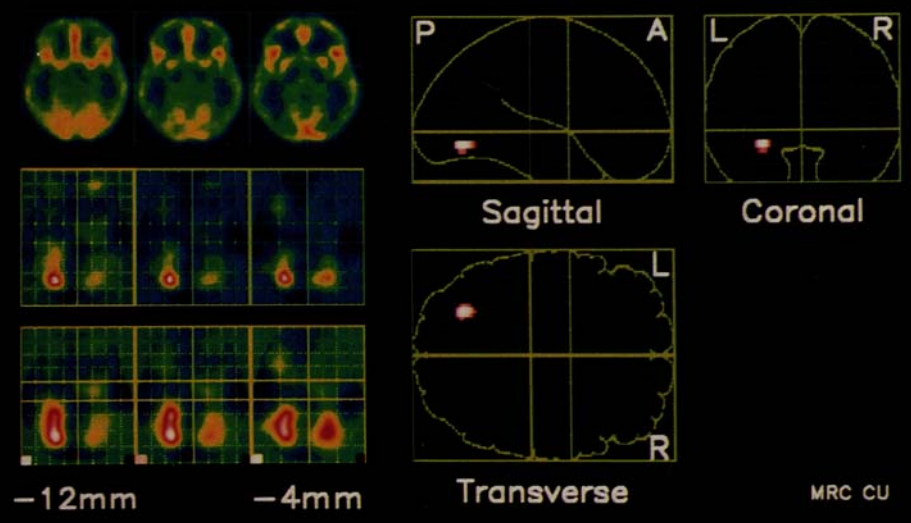
**Désavantage:** activité moyenne de millions de neurones, à travers un filtre hémodynamique, comparé à une condition contrôle. Ne mesure pas de sélectivité mais la 'sensibilité'.

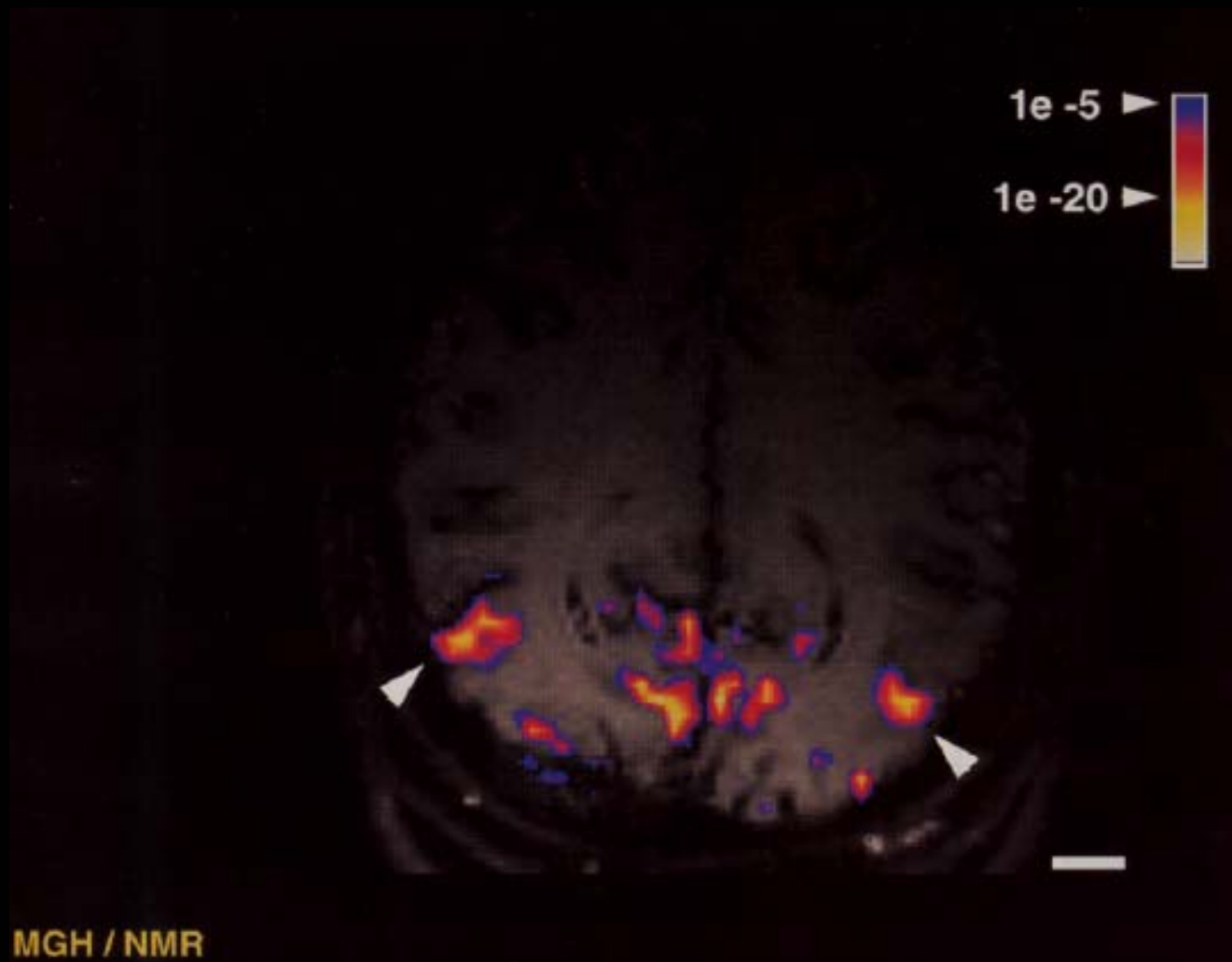
**Avantage:** visualise l'activité de tout le cerveau ( à l'opposé de l'extrême détail de l'enregistrement unitaire). Ainsi on passe de la notion de centre à la notion de réseau (proche de l'idée sortie du système visuel)

## A Motion Study: Motion vs. Stationary



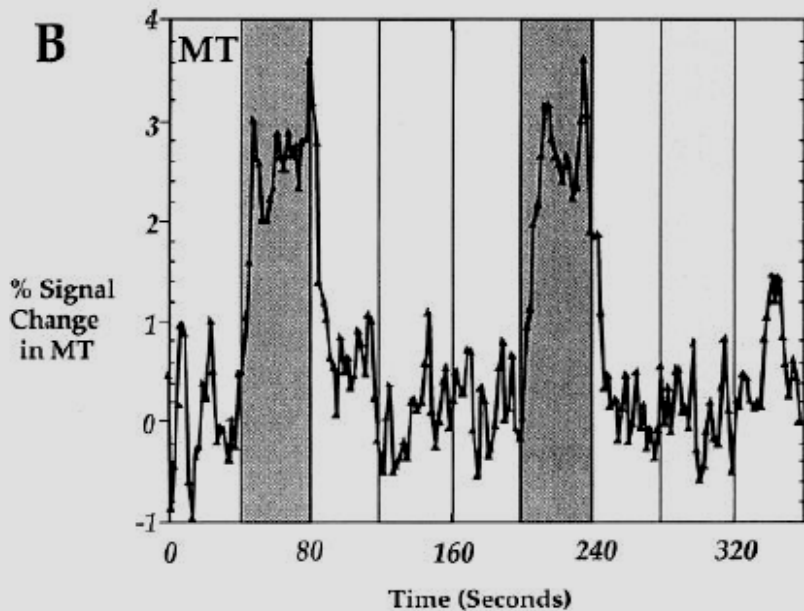
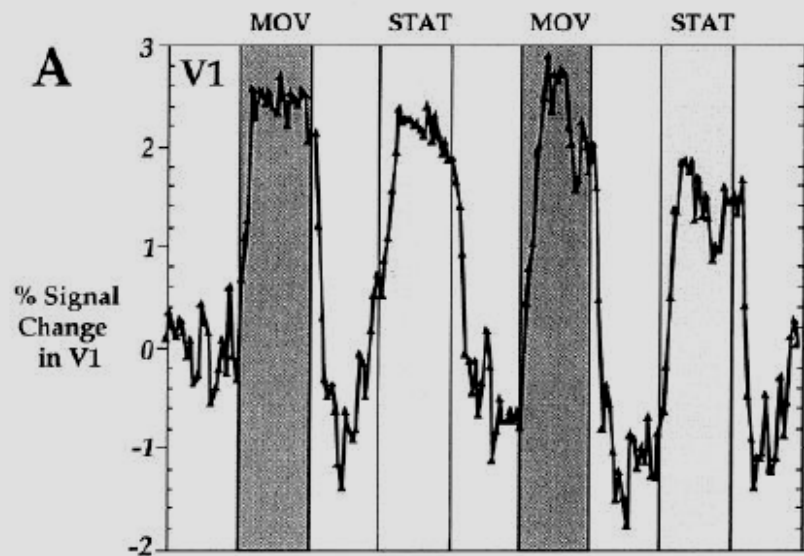
## B Colour Study: Colour vs. Grey





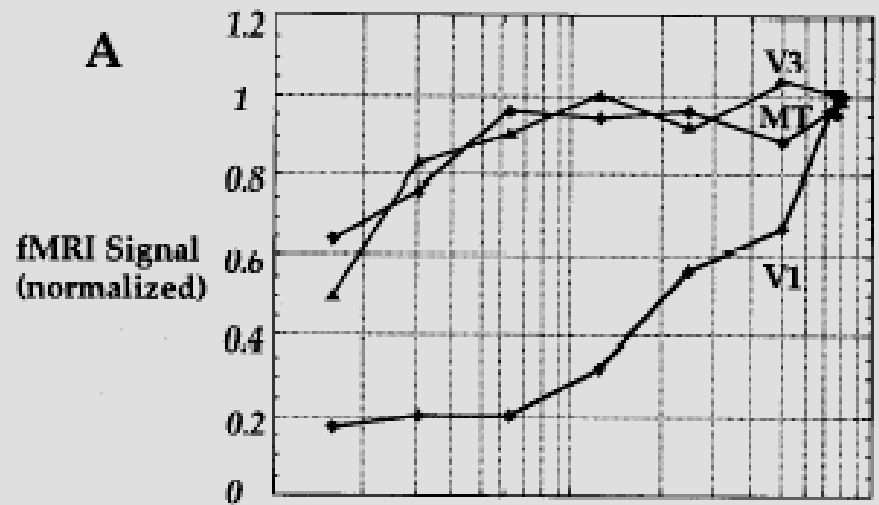
**Activation bilatérale MT/V5 (flèches) dans la soustraction mouvement (radial) moins stationnaire;  
sur ligne médiane activation V1/V2**

# SENSIBILITE AU MOUVEMENT : UNE REGION

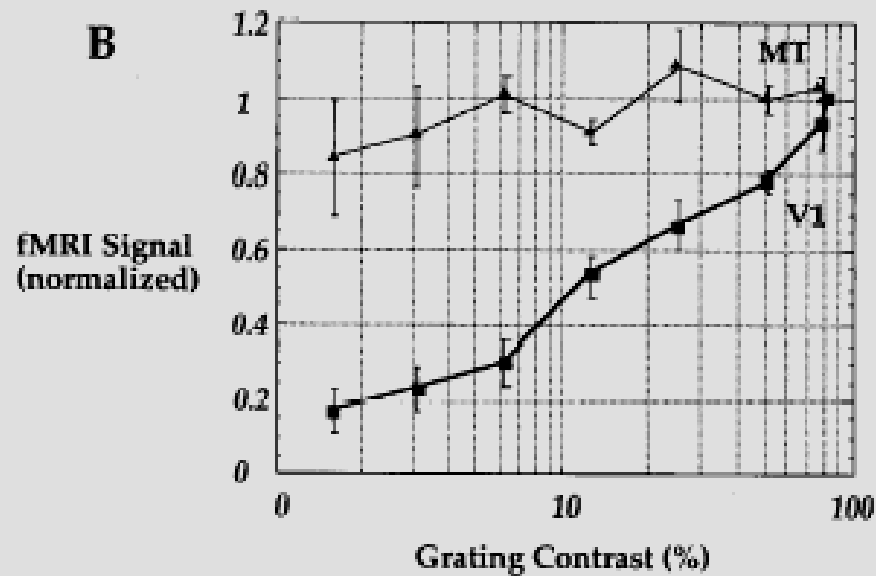


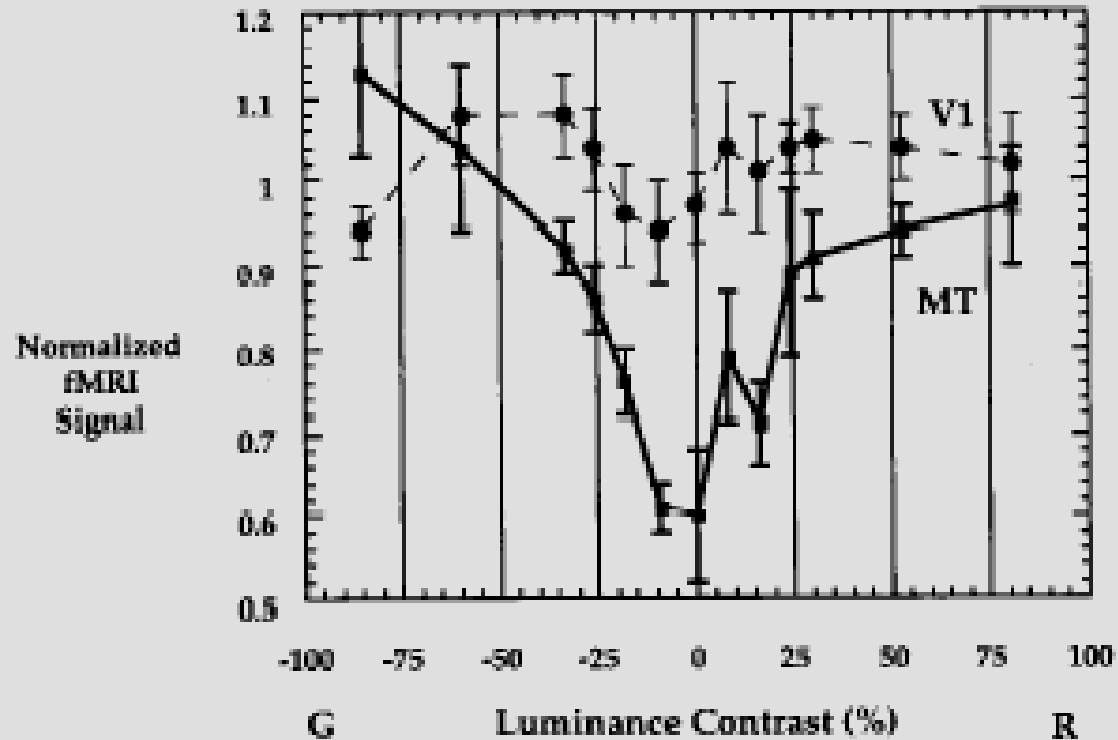
Décours temporel activation dans V1 et MT/V5 pour condition de mouvement et pattern stationnaire alternant avec écran vide

# SENSIBILITE AU MOUVEMENT : UNE REGION



Courbes signal IRMf-contraste dans MT/V5 et V1  
A sujet unique  
B moyenne 4 sujets

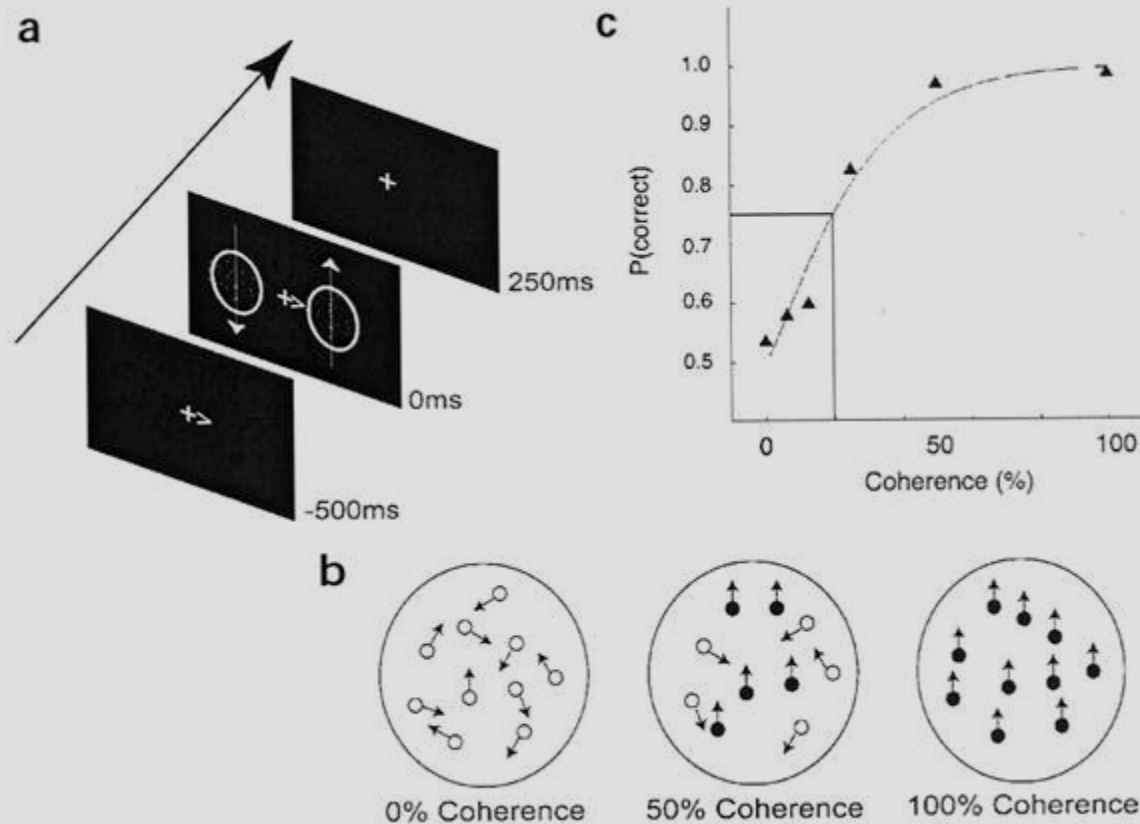




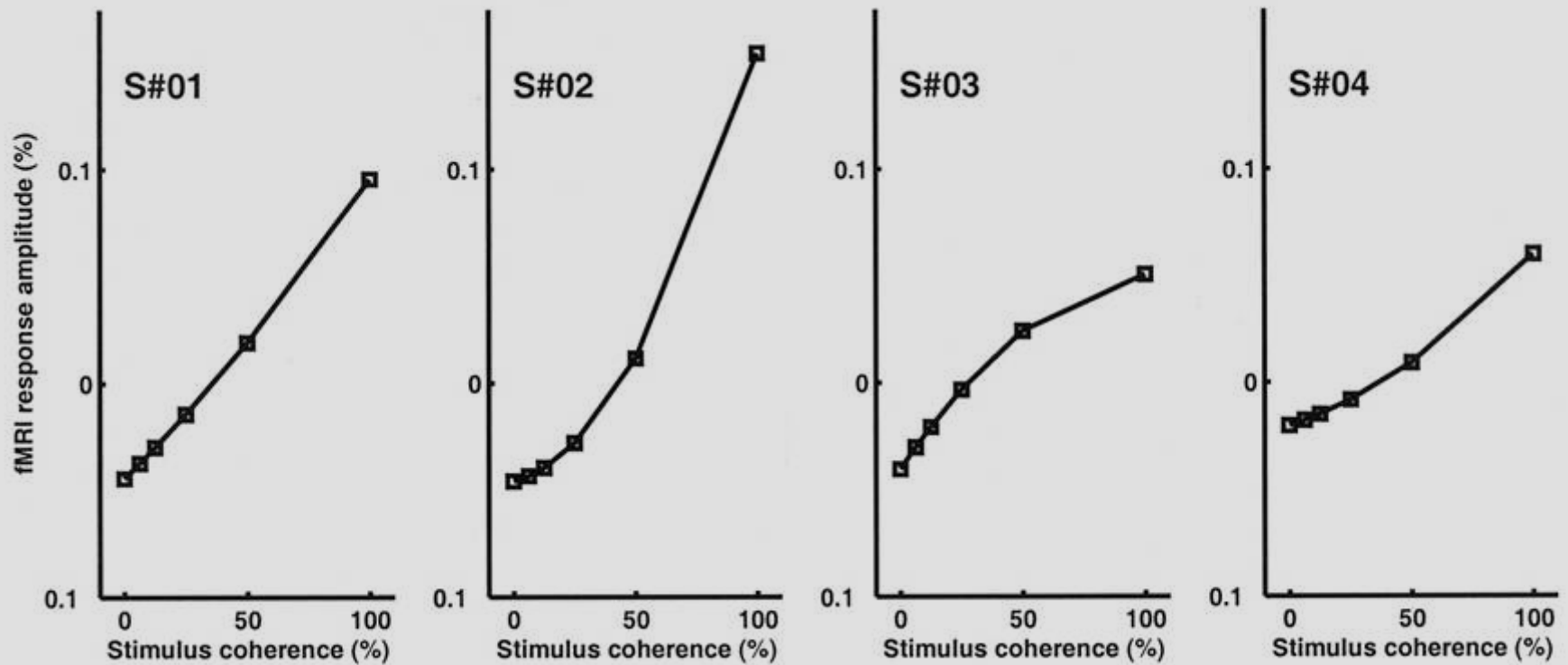
Courbes signal IRMf-contraste (de luminance) pour un stimulus coloré ( réseau vert-rouge) dans MT/V5 (minimum) et V1 ( peu d'effet) ; moyenne de 3 sujets



# SENSIBILITE AU MOUVEMENT : UNE REGION

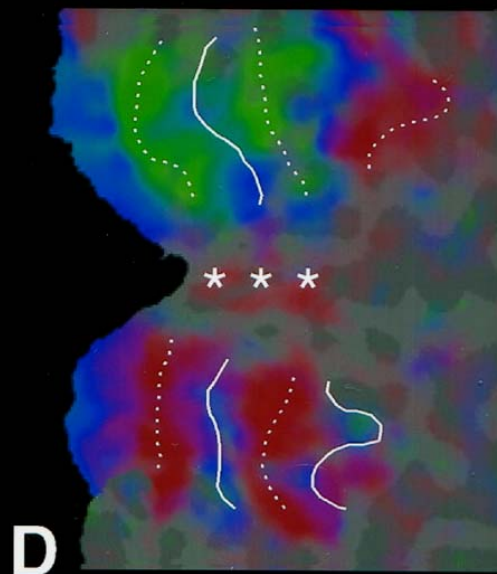
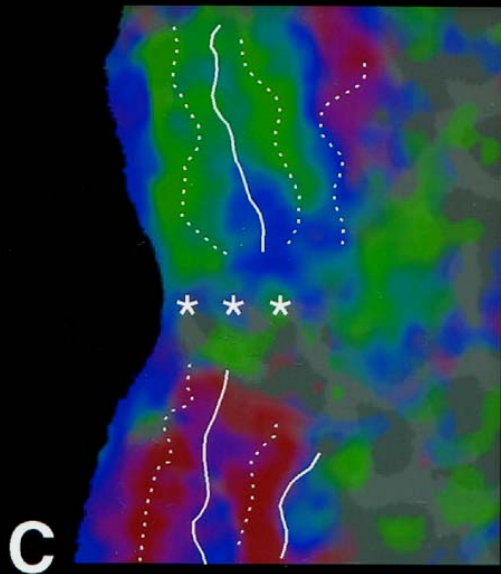
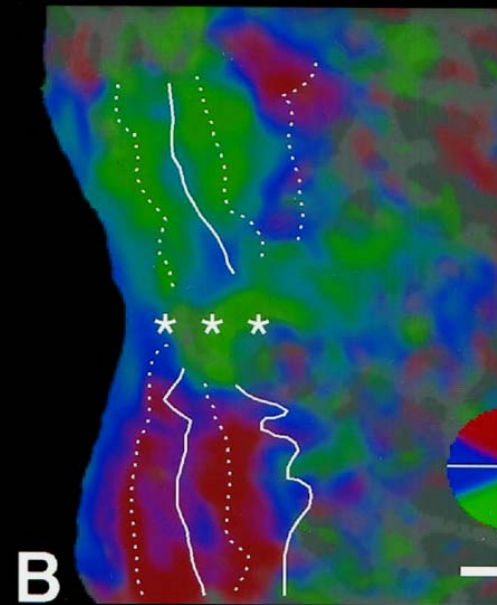


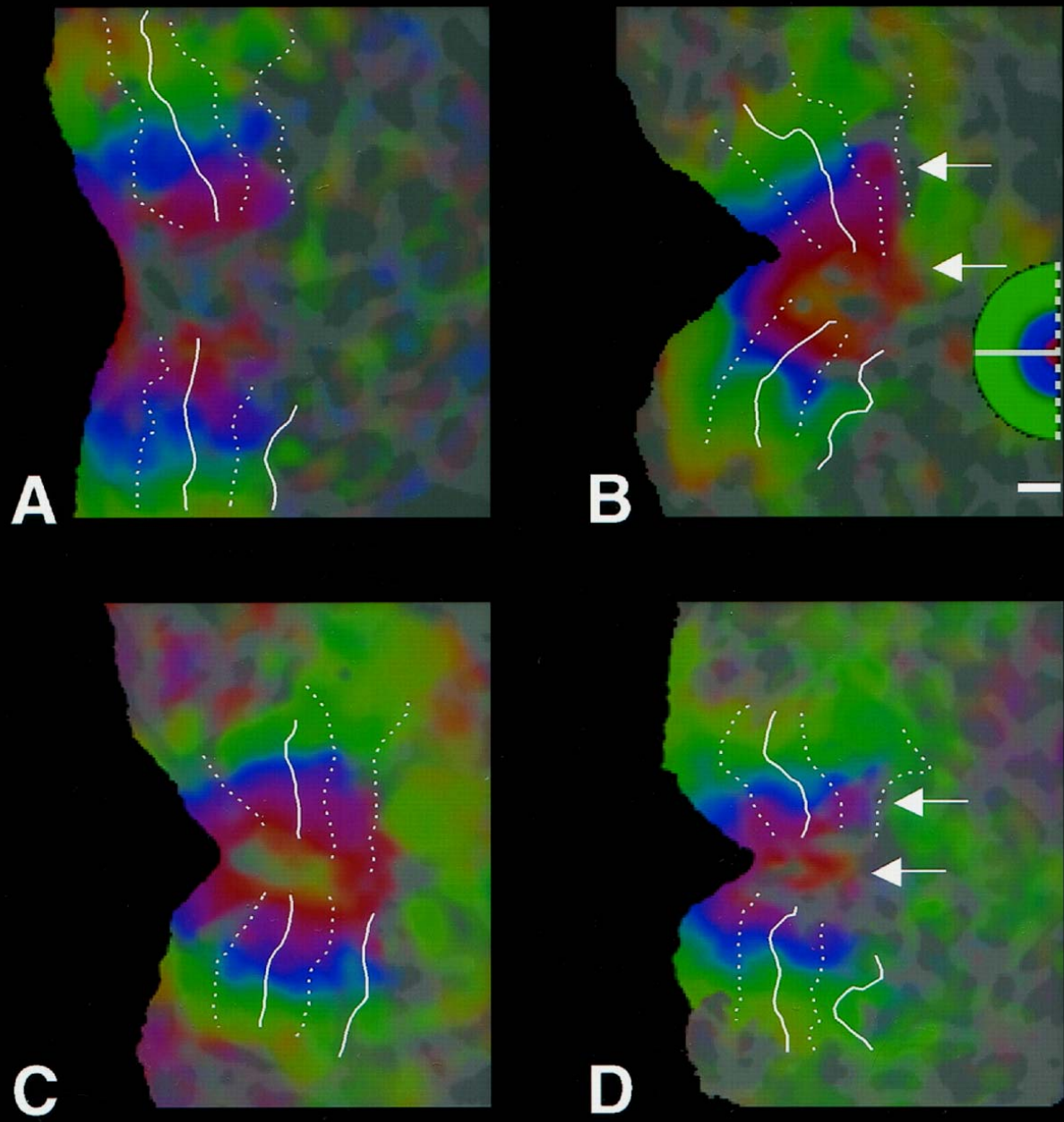
Manipulation % dots cohérents dans une des ouvertures (indiquée par triangle) ; courbe psychophysique d'un sujet (jugement grossier de direction)



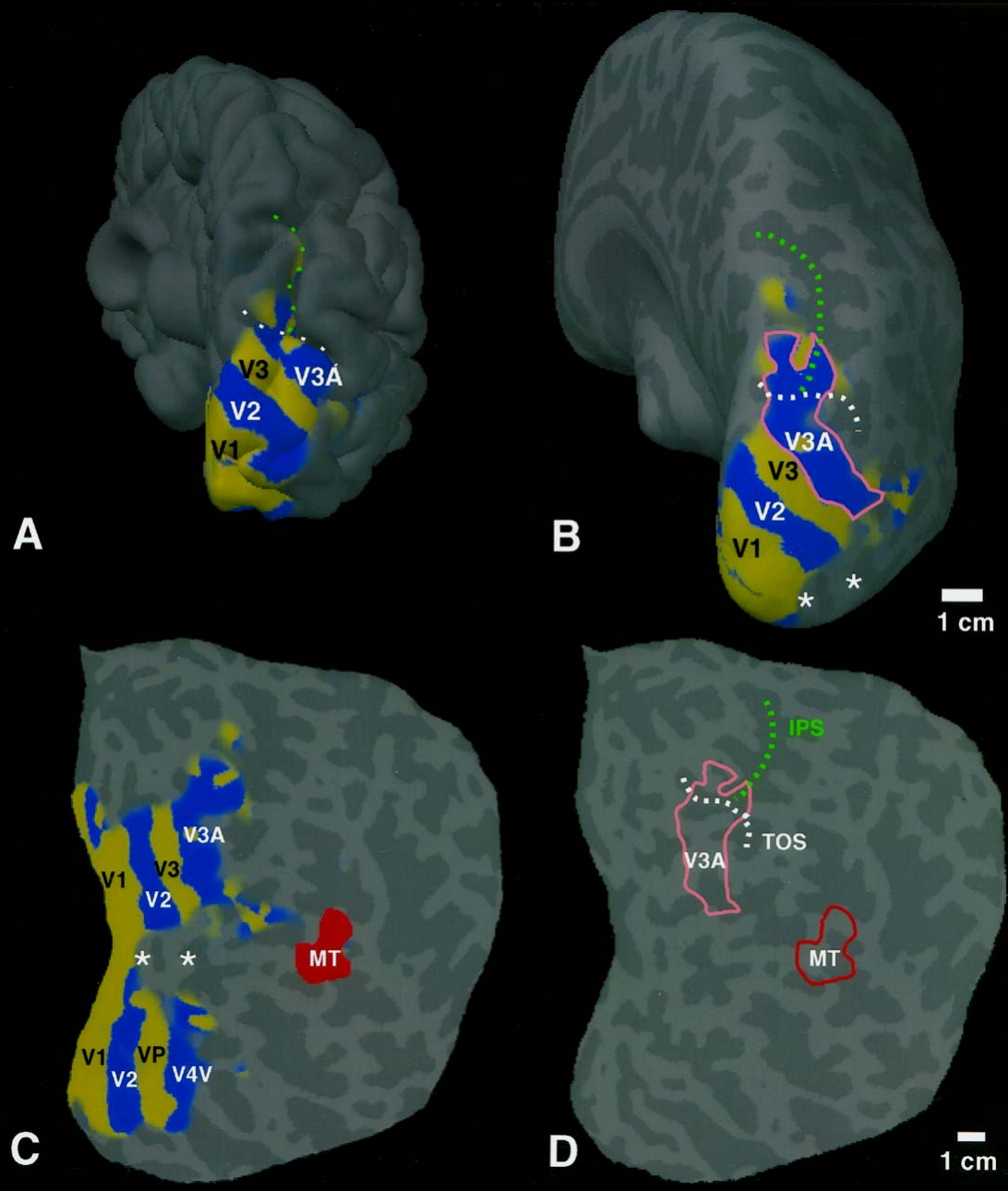
Courbes signal IRMf-% dots cohérents dans MT/V5 de 4 sujets

calcarine

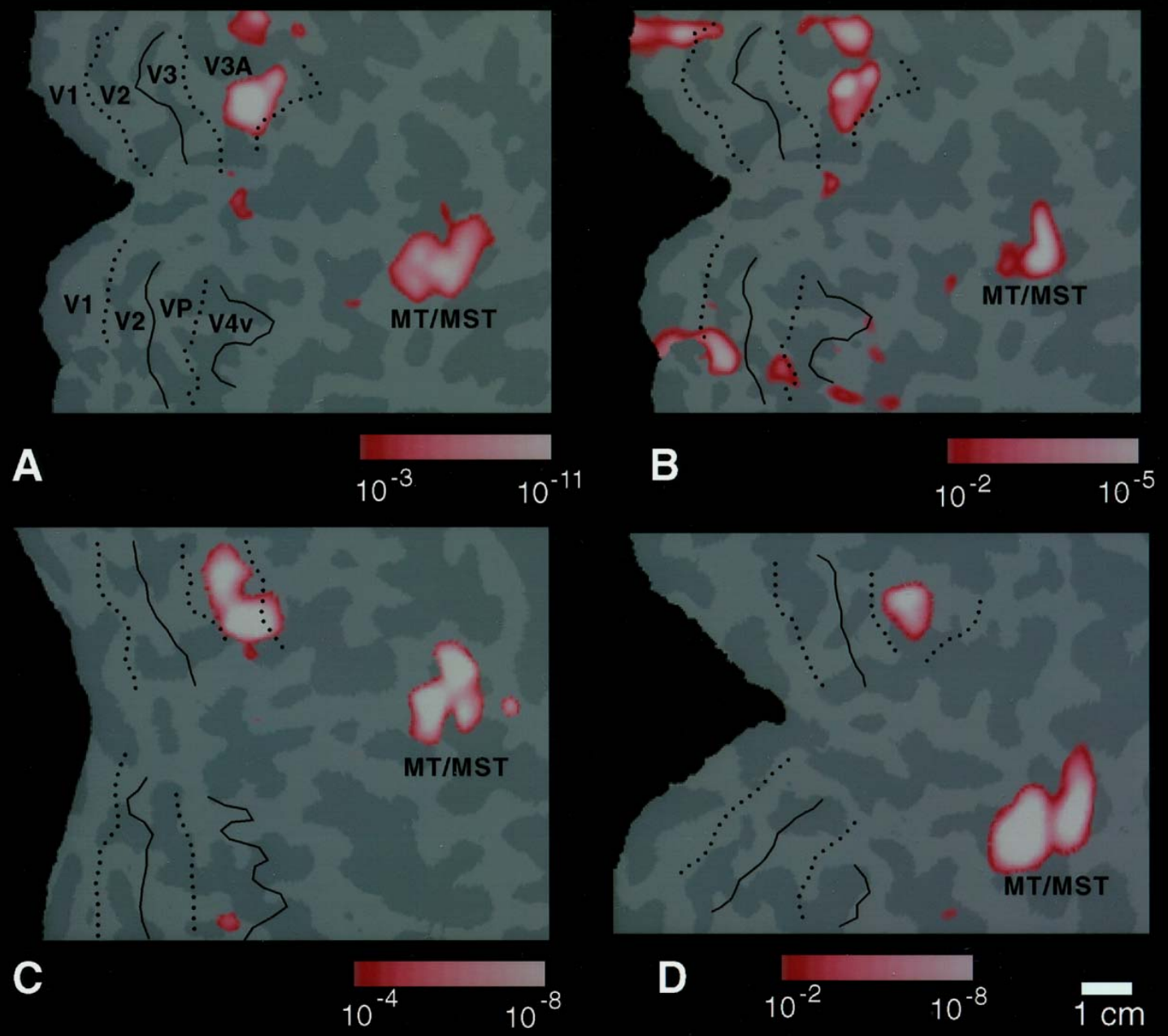




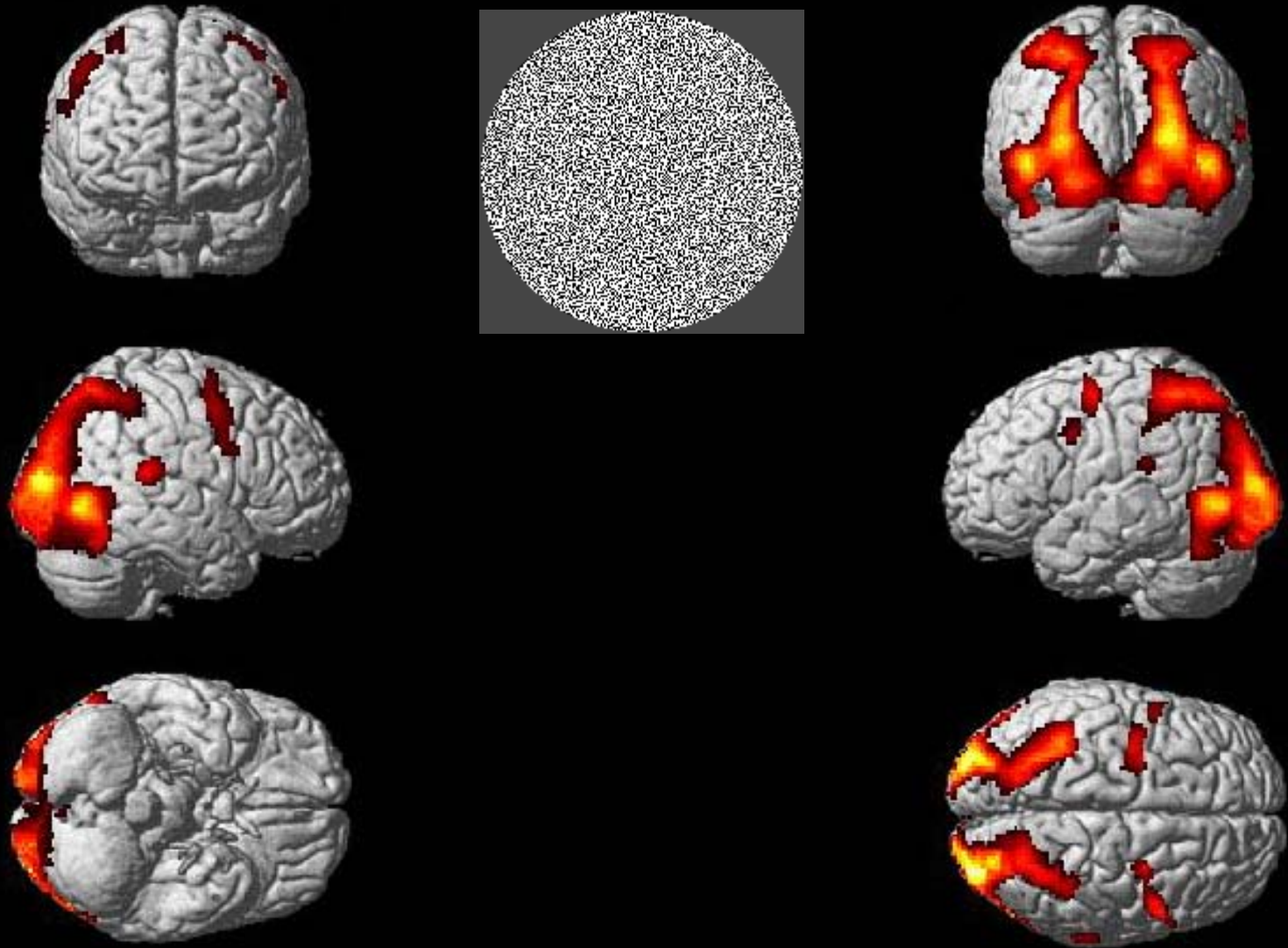
# SENSIBILITE AU MOUVEMENT : UNE SECONDE REGION



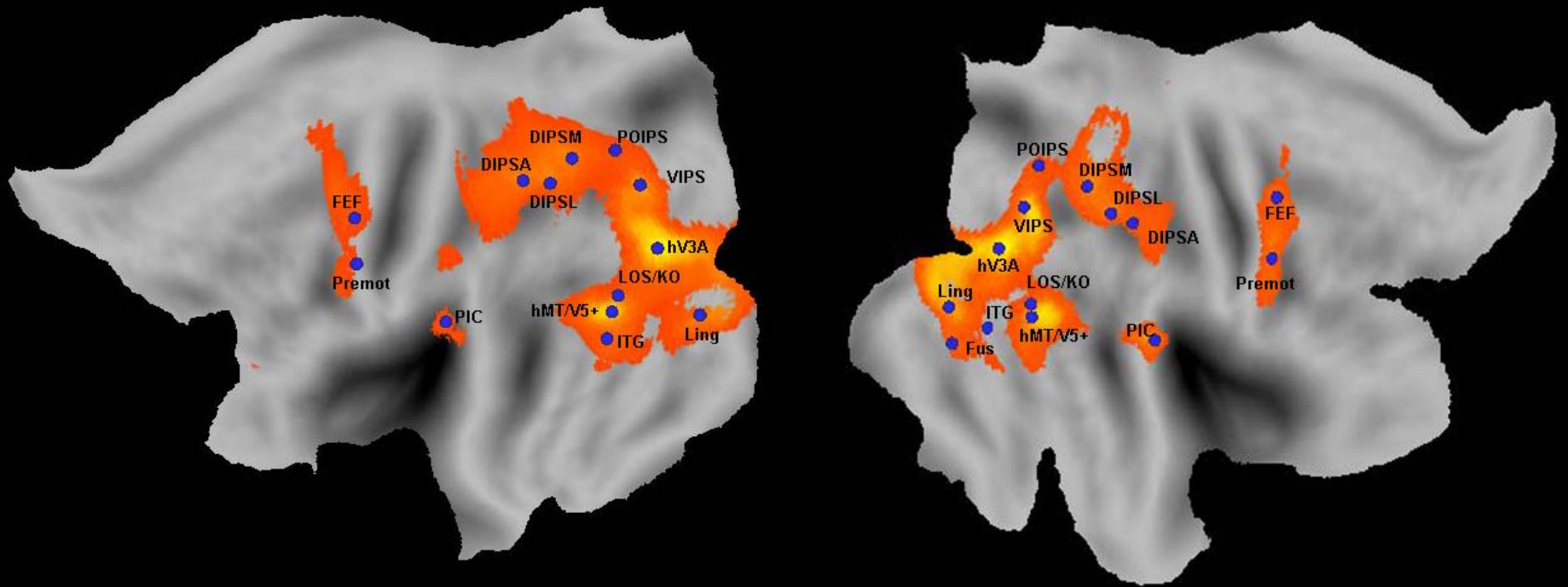
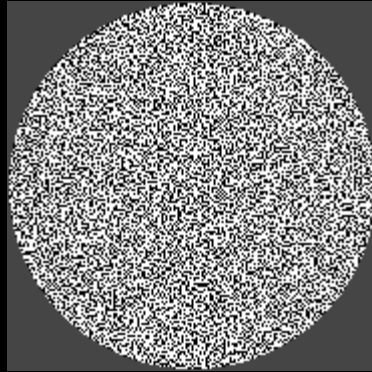
# SENSIBILITE AU MOUVEMENT : UNE SECONDE REGION



7deg

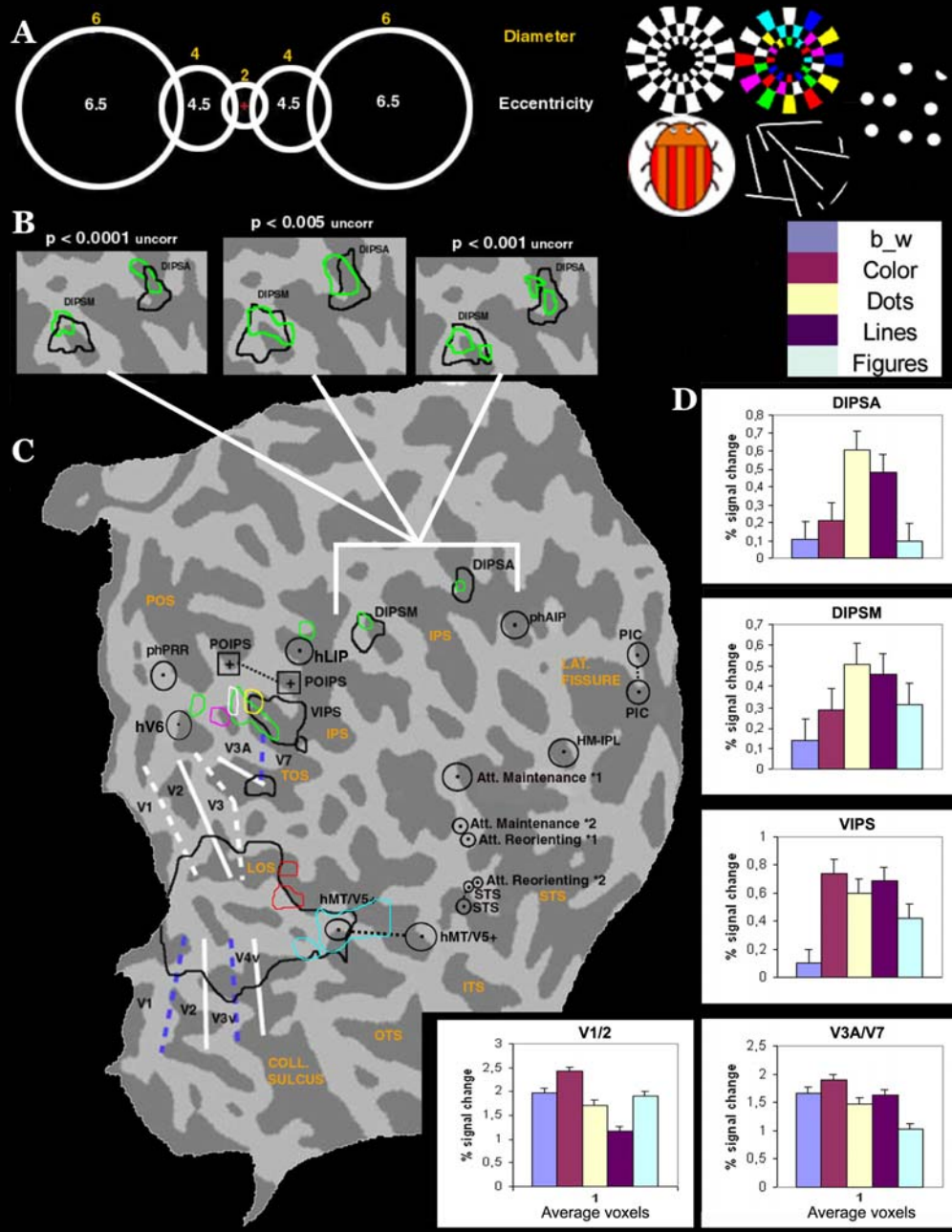


# SENSIBILITE AU MOUVEMENT : BEAUCOUP DE REGIONS





# SENSIBILITE AU MOUVEMENT : BEAUCOUP DE REGIONS



a Low-green



b Medium-green

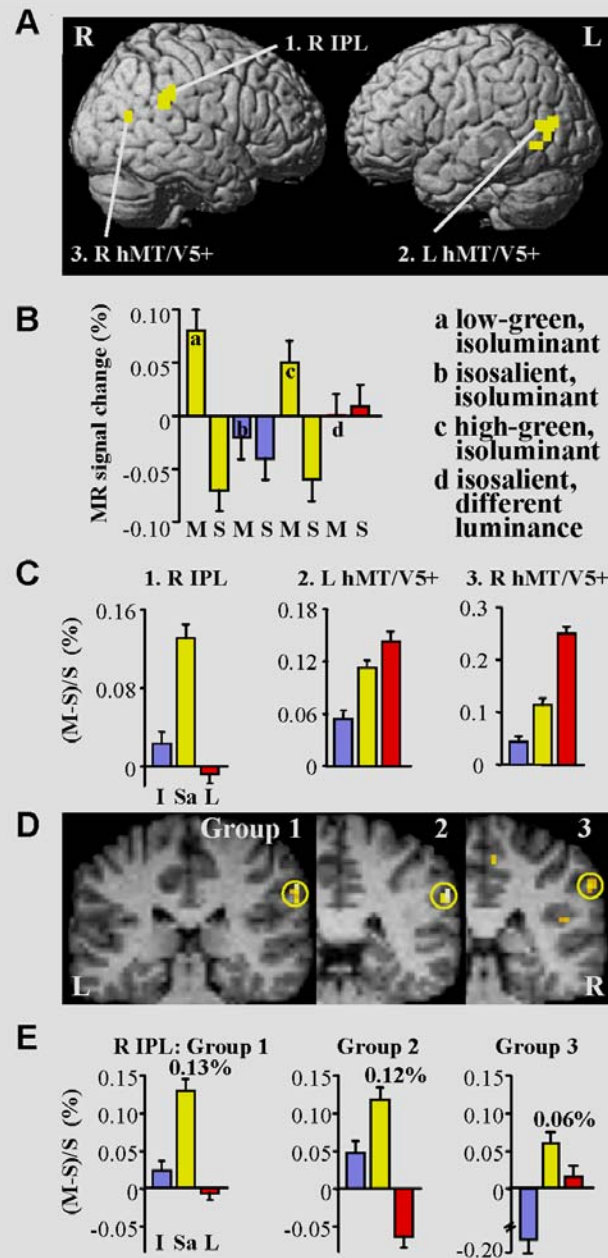


c High-green



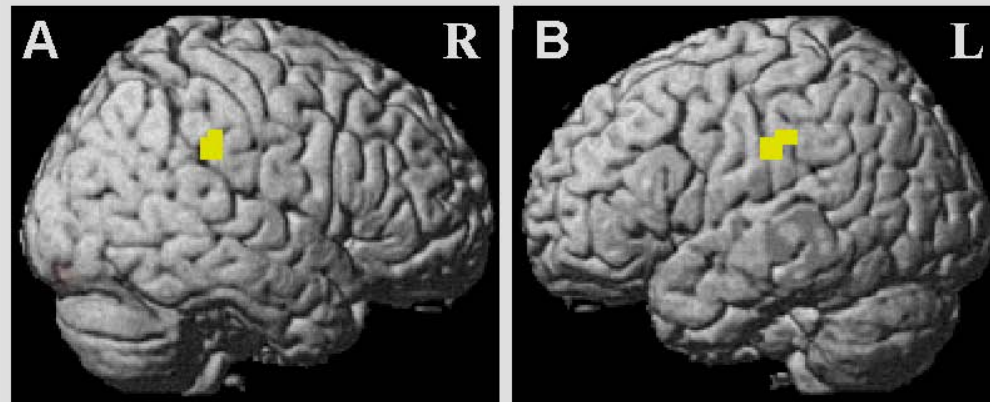
Stimulus Configuration in Main Experiment 1 and Control 1 Stimuli in the low-green (A), medium-green (B), and high-green (C) saturation isoluminant conditions are shown. The black arrow indicates the direction of the perceived motion.

# SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )

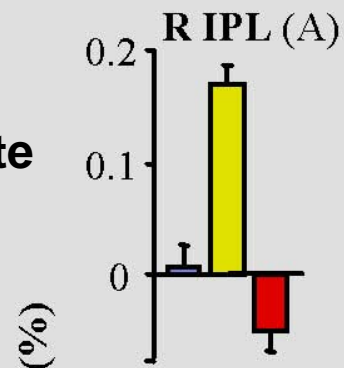


The Higher-Level Feature-Tracking Motion System: Main Experiment 1(A) Statistical parametric maps (SPMs) showing voxels significant ( $p < 0.05$  corrected for multiple comparisons) in the group analysis (main experiment 1, two highest attention scan sessions) for the subtraction moving minus stationary in the different salience conditions, rendered on the standard right and left hemispheres.(B) Activity profile of R IPL (66, -36, 33) in which the relative (to fixation) adjusted MR signal is plotted as a function of the eight stimulus conditions: moving (M) and stationary (S) stimuli in the isosalient (b)-isoluminant (blue), different salience (a and c) -isoluminant (yellow), and isosalient-different luminance (d, red) conditions; letters as in Figure 1.(C) Functional profiles of R IPL, L hMT/V5+ (-42, -66, 12), and R hMT/V5+ (54, -66, 15) plotting the average percentage MR signal change (M-S/S) for the moving (M) compared to the stationary (S) stimuli in the isosalient-isoluminant (I, blue), different salience-isoluminant (Sa, yellow), and isosalient-different luminance (L, red) conditions.(D) SPMs of the three group analyses for the subtraction as in (A), projected onto a coronal slice selected to show the R IPL activation: group 1 (highest attention sessions): 66, -36, 33; group 2: 66, -30, 39; group 3 (lowest attention sessions): 66, -33, 39; 1 and 2 at  $p < 0.05$  corr., 3 at  $p < 0.001$  uncorr.(E) Functional profiles of right IPL in the three groups of two scanning sessions, each in decreasing order of attention to the stimulus motion. Percentages indicate size of saliency-based motion effect, other conventions as in (C). R, right; L, left; IPL, inferior parietal lobule; hMT/V5+, human middle temporal complex. Error bars indicate SD.

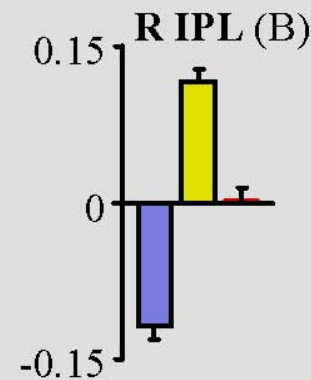
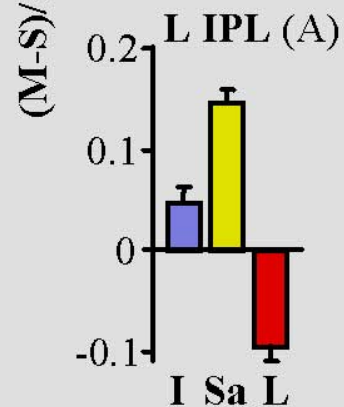
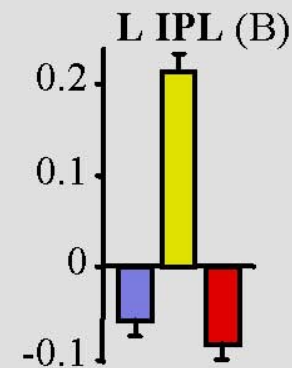
# SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )



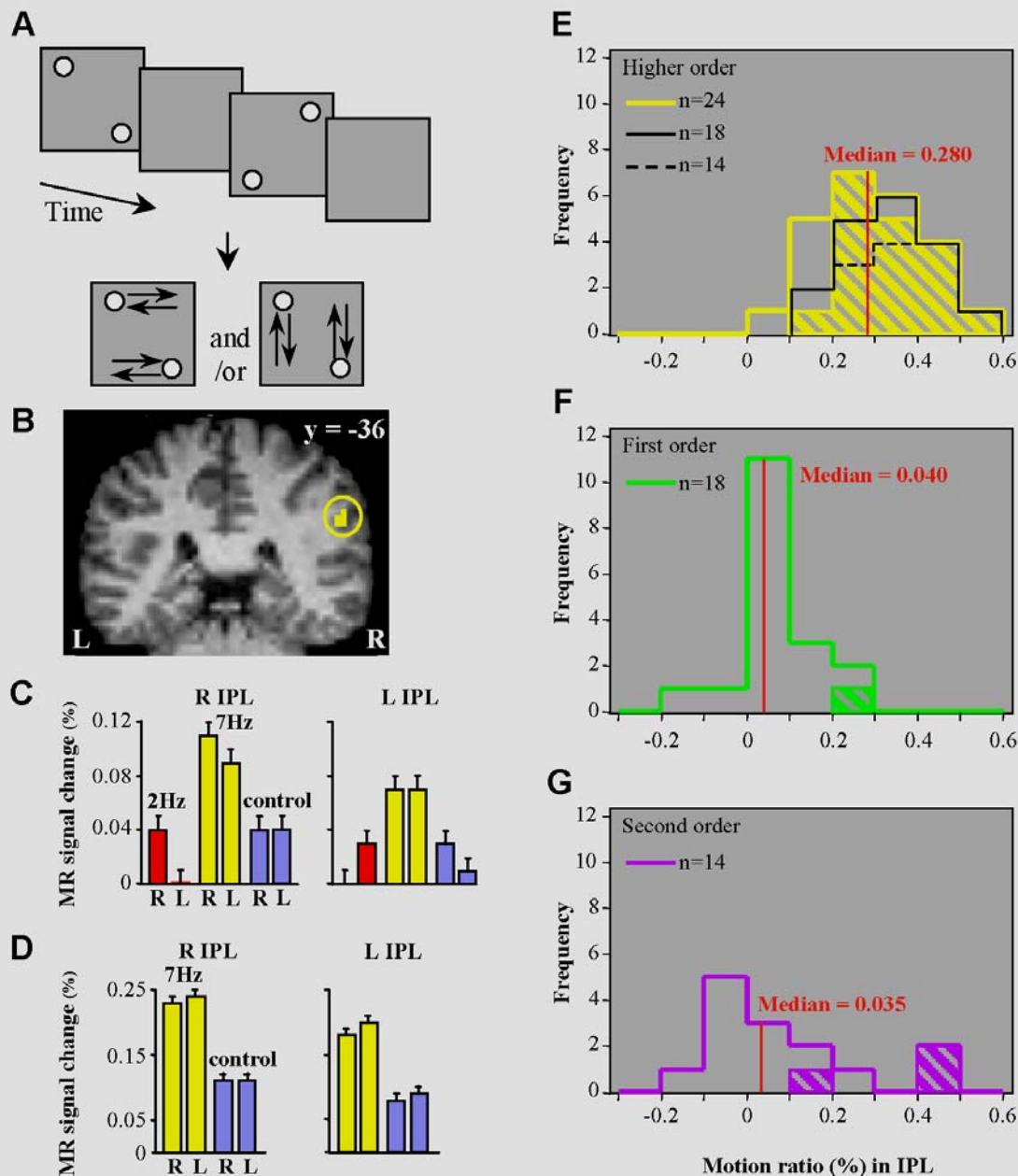
Stim a droite



Stim a gauche

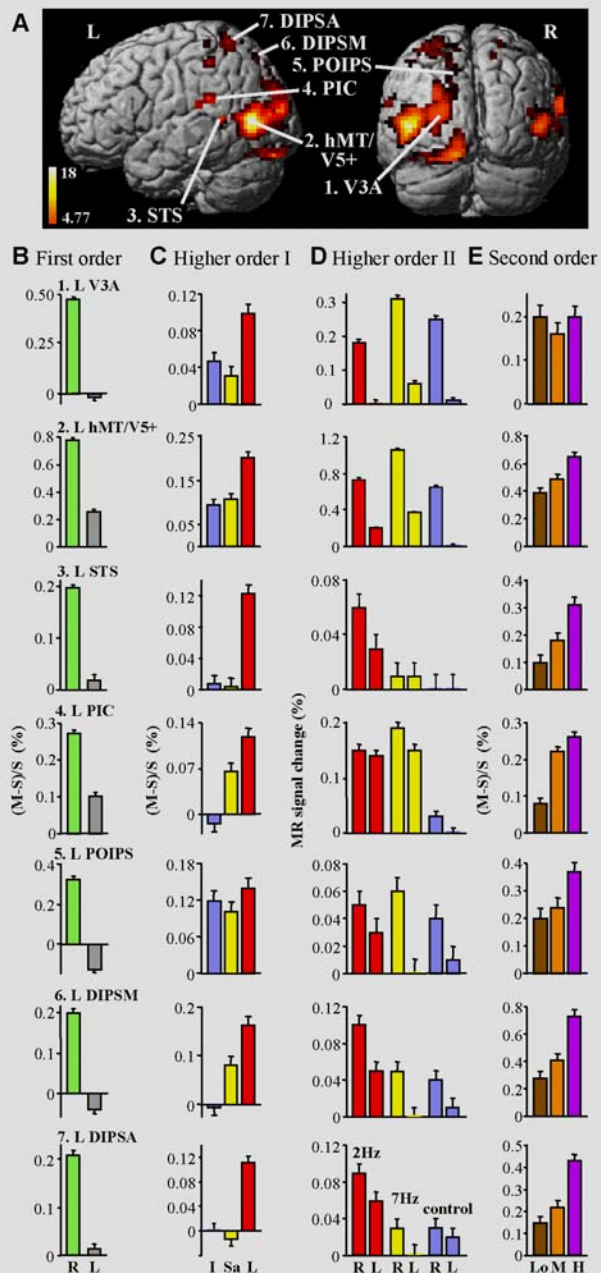


# SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )



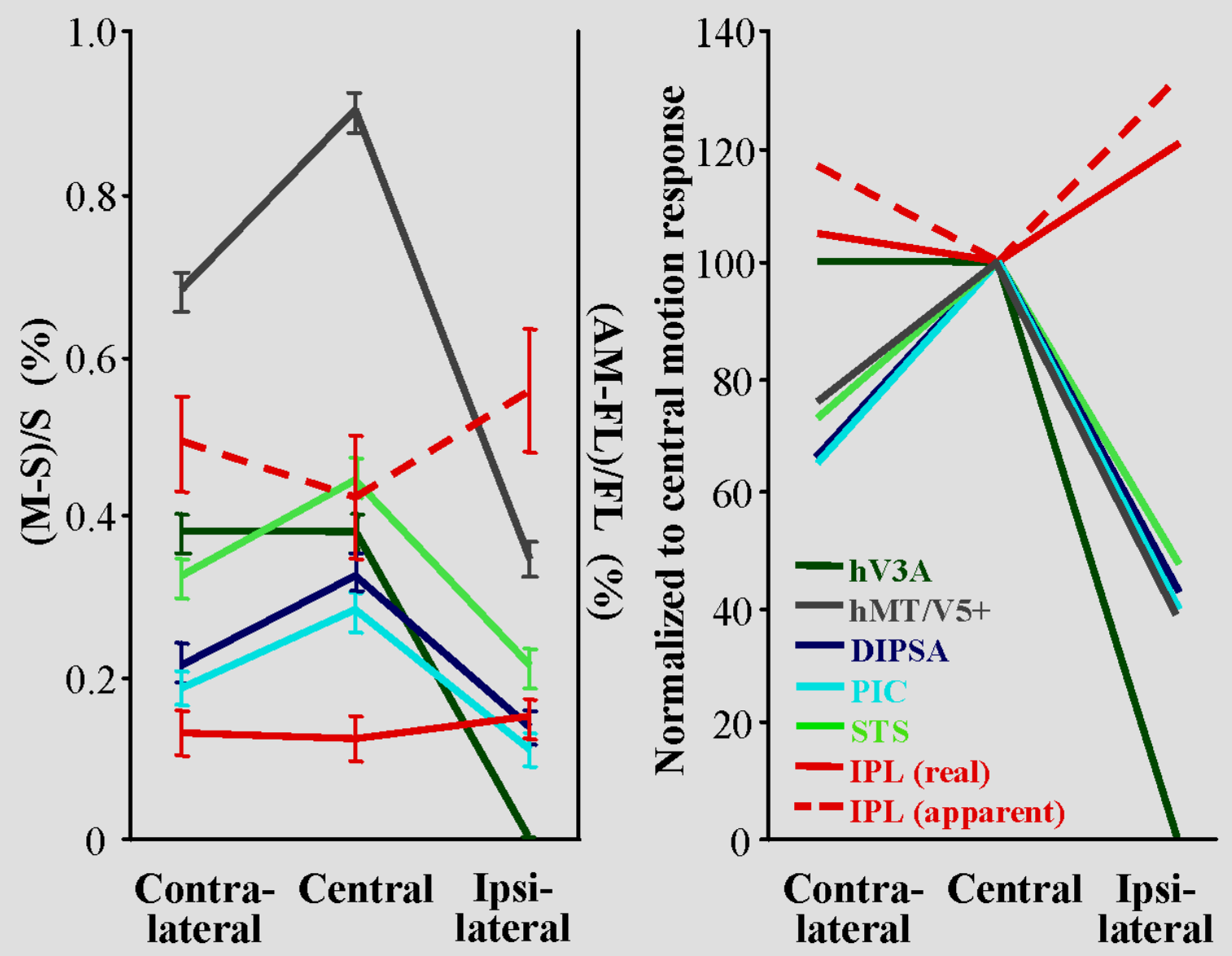
Response of IPL to Apparent Motion Stimulus(A) Stimulus configuration in main experiment 2 and control 3 and 4.(B) SPM showing the right IPL activation (60, -36, 30; encircled in yellow) in the random-effect group analysis (main experiment 2, colored voxels  $p < 0.001$  uncorr.) for the subtraction 7 Hz apparent motion conditions minus 7 Hz control conditions, averaged over R and L presentations, overlaying an anatomical coronal slice at antero-posterior level  $Y = -36$  in Talairach space.(C) Corresponding activity profiles of right IPL (see [B]) and left IPL (-57, -39, 36; random-effect group analysis,  $p < 0.01$  uncorr.). Same conventions as in [Figure 3](#).(D) Activity profile of right (63, -36, 30;  $p < 0.05$  corr.) and left IPL (-63, -39, 33;  $p < 0.05$  corr.) in control experiment 4.(E-G) Distributions of motion ratios (M-S/S) in individual hemispheres (n) of main experiment 2 (E), control experiment 2 (F) and control experiment 5 (G). Ratios were averaged over right and left stimulus presentations in (E) and (F) and over levels of coherence in (G). Hatched bars indicate significant activation ( $p < 0.001$  uncorr.).

# SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )

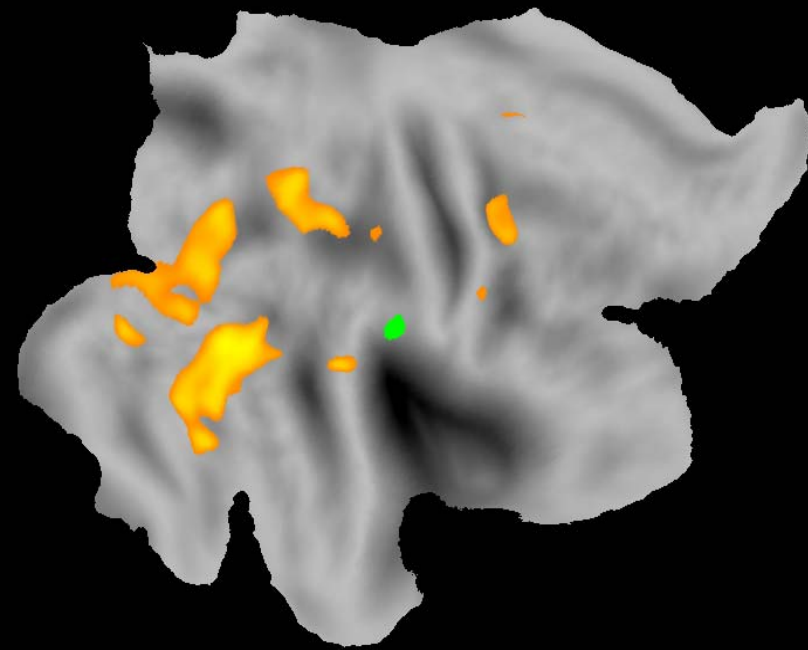
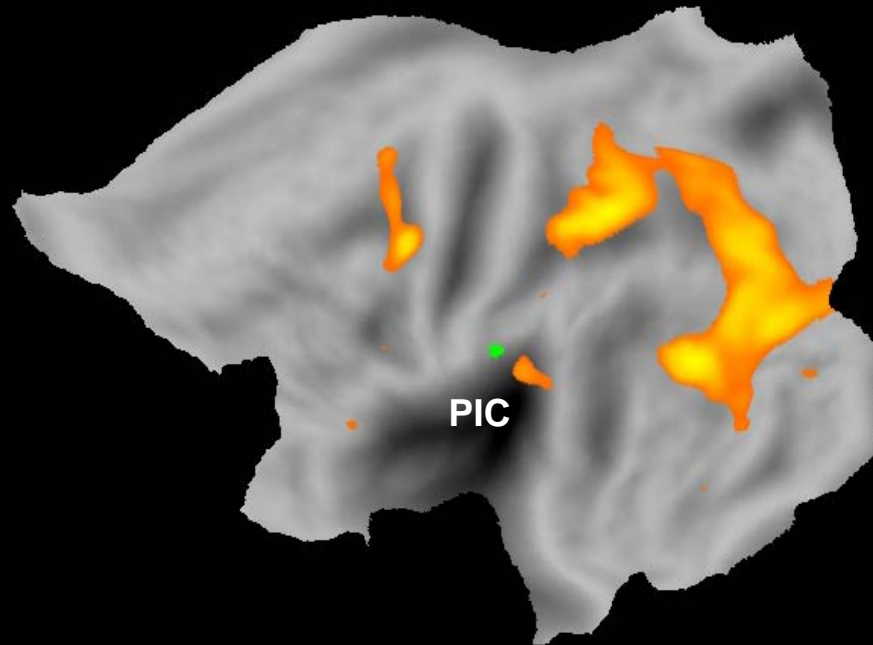
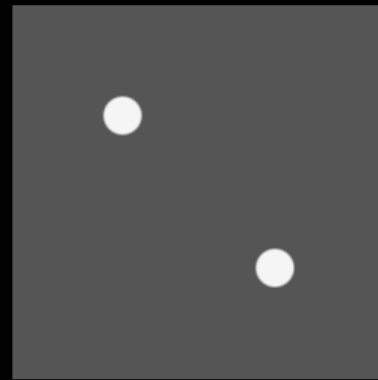


Cortical Regions of the Lower-Level Motion System(A) Statistical parametric maps showing voxels significant ( $p < 0.05$  corr.) in the group analysis for the subtraction moving minus stationary random texture stimulus (control experiment 2), superimposed on the left standard hemisphere in a lateral and posterior view. The stimulus was located in the right visual field. The color bar indicates z scores.(B) Corresponding functional profiles of the main lower-level motion areas (see coordinates below) plotting % MR signal change (M-S/S) in the moving (M) compared to the stationary (S) conditions for a stimulus located in right (R), contralateral (green), and left (L), ipsilateral (gray) visual field.(C and D) Activity profiles of these areas for the conditions of the first (C) and second (D) main experiment (local maxima in left hemisphere at  $p < 0.001$  uncorr.).(E) Activity profiles of these areas in control experiment 5 (average of R and L hemispheres, local maxima at  $p < 0.001$  uncorr.) in the low (Lo, brown), medium (M, orange), and high (H, purple) coherence conditions. In (A) and (B) hV3A (-21, -90, 15), indicates human visual area 3A; hMT/V5+ (-42, -69, 6), human middle temporal complex; STS (-57, -48, 6), superior temporal sulcus; PIC (-51, -30, 21), posterior insular cortex; POIPS (-15, -84, 45), parieto-occipital intraparietal sulcus; DIPSM (-12, -63, 63), dorsal intraparietal sulcus medial; DIPSA (-30, -36, 63), dorsal intraparietal sulcus anterior.

**SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )**



# SENSIBILITE AU MOUVEMENT : REGION DE HAUT NIVEAU ( IPL – HMA )



First order motion

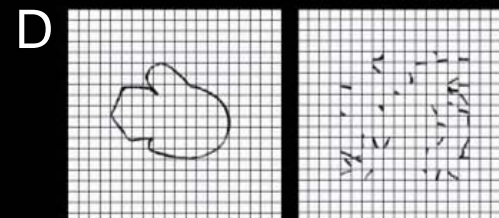
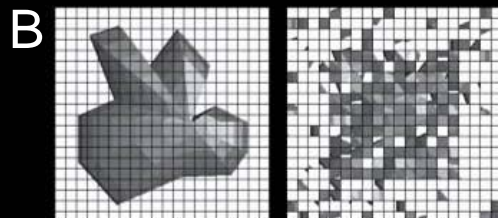
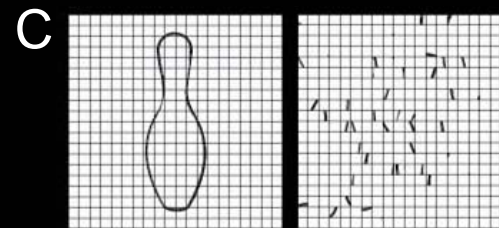
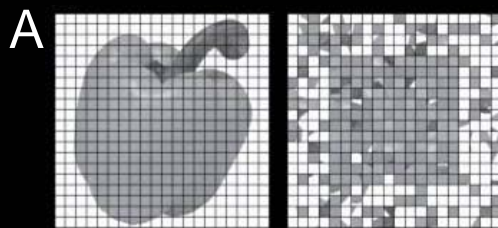


HM-IPL

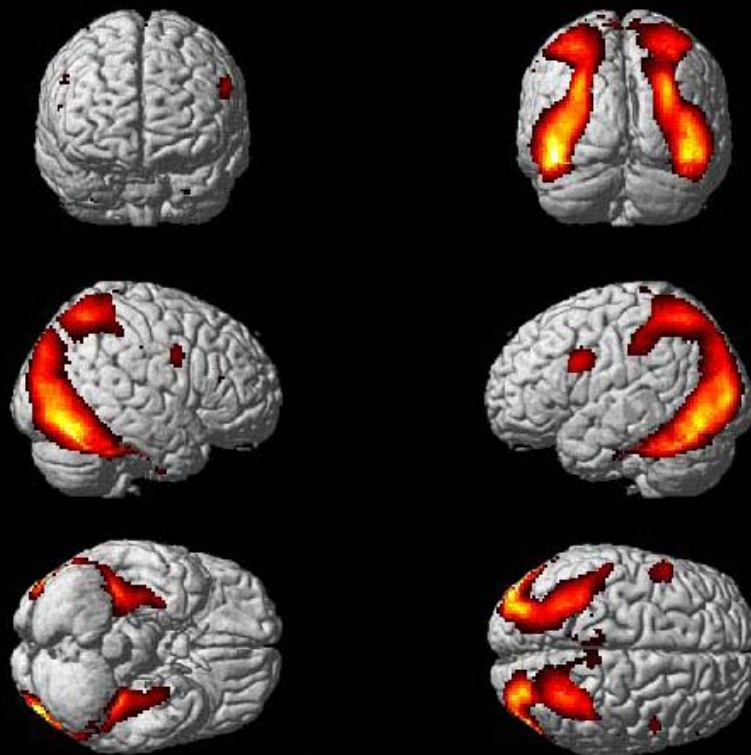
$p_{uncorr} < 0,001$



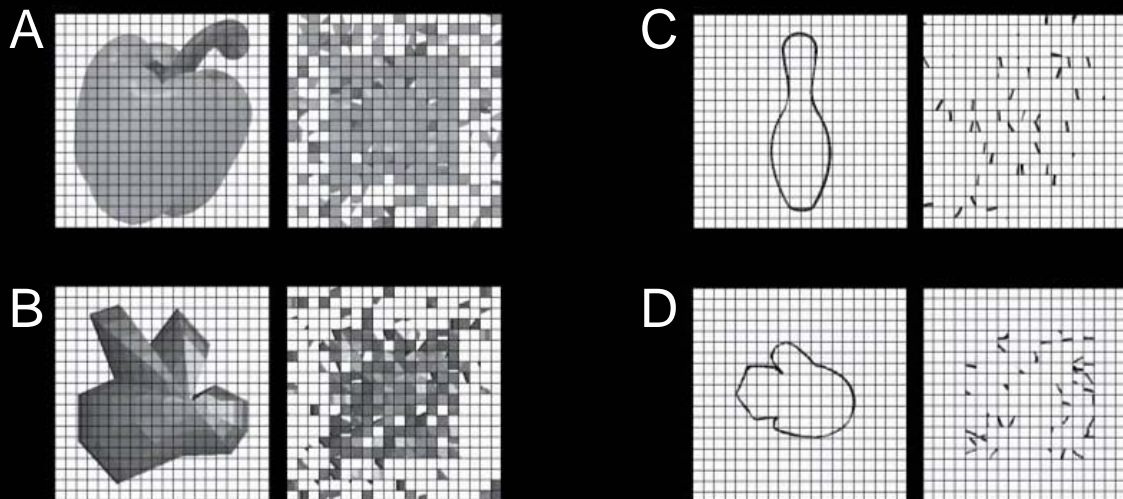
# SENSIBILITE A LA FORME BI-DIMENSIONNELLE



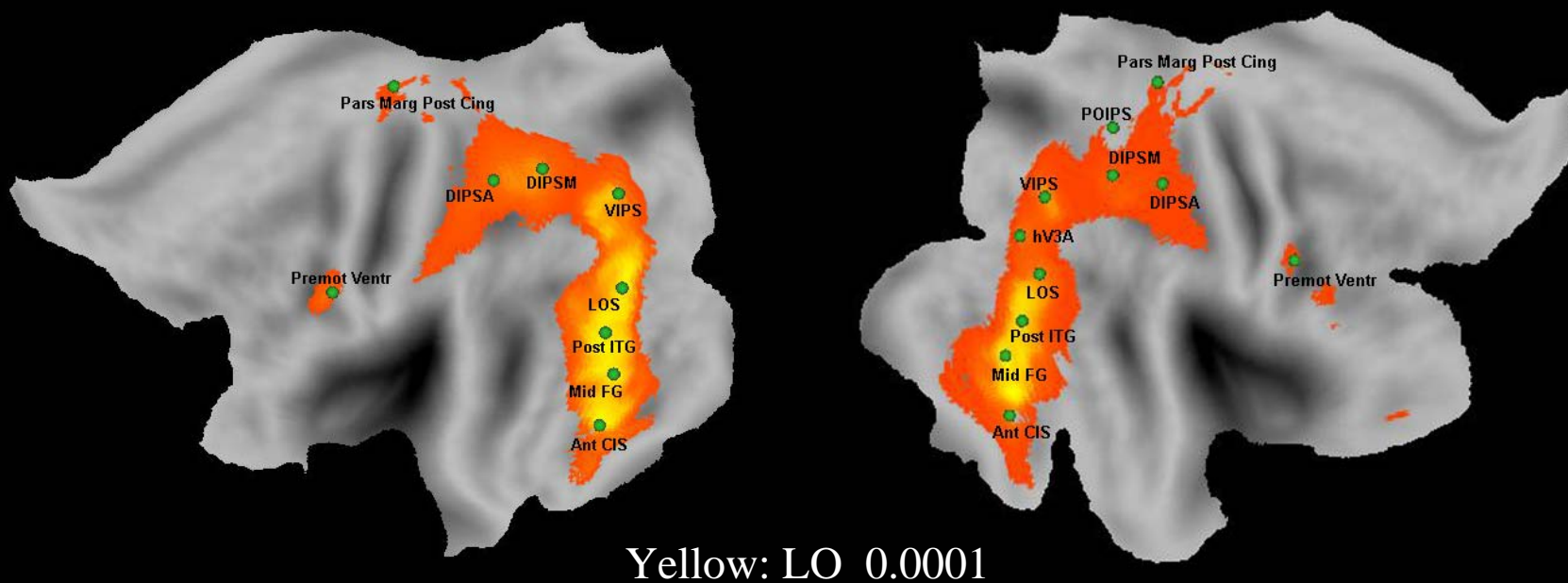
15 deg



# SENSIBILITE A LA FORME BI-DIMENSIONNELLE

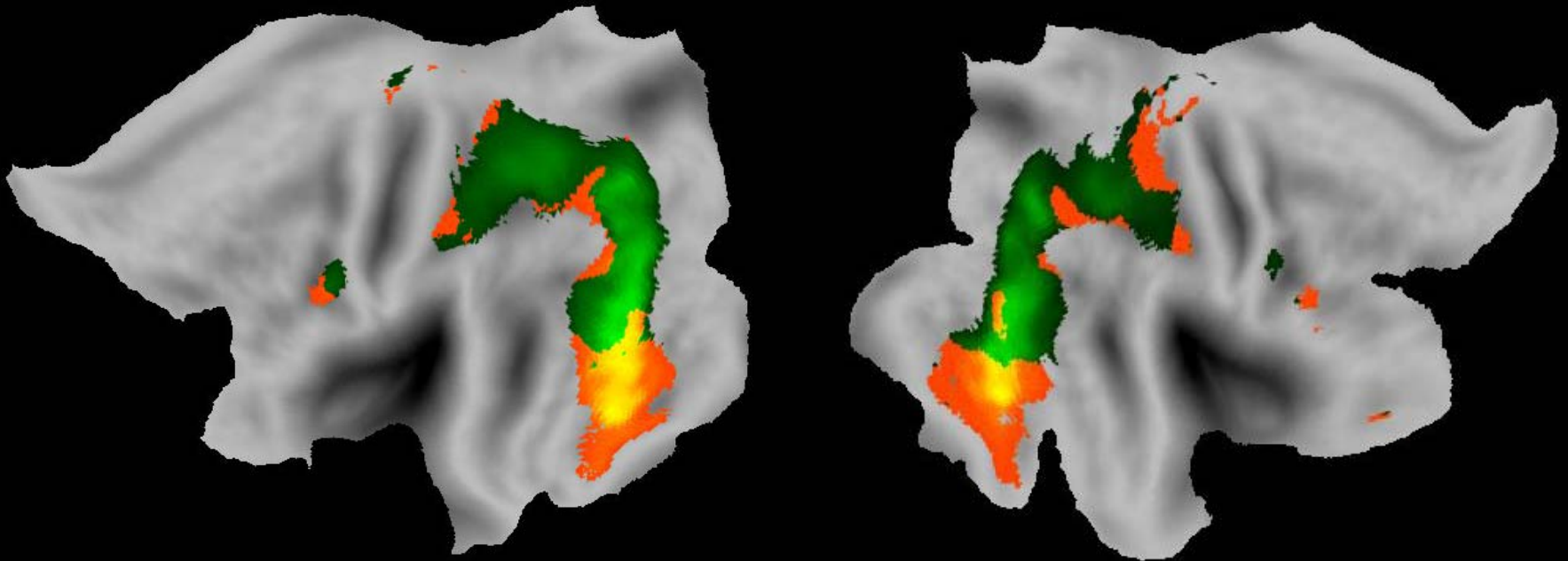


Flat LO localizer with foci



Yellow: LO 0.0001

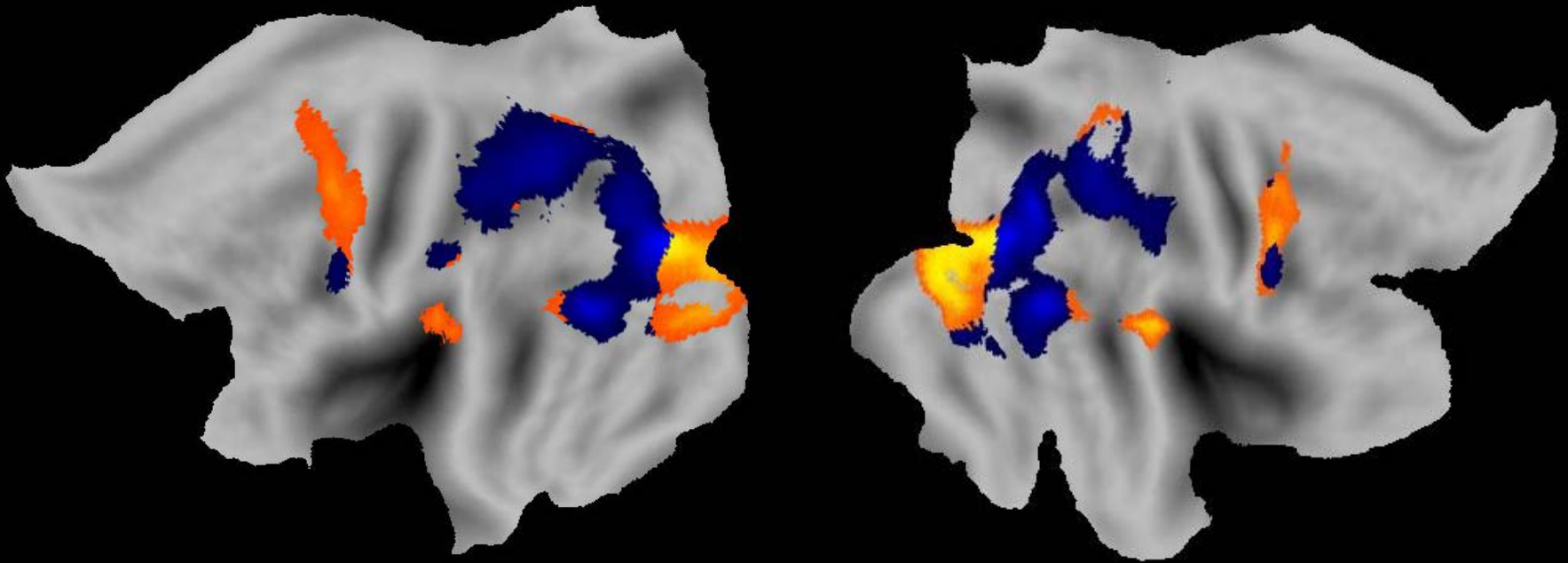
Flat LO localizer



Green: LO localizer (0.0001)

Yellow: LO masked with ML @0005

Flat Motion localizer



Blue: ML localizer (0.0001)

Yellow: ML masked with LO @0005

## **Conclusions:**

### **1: Notion de réseau ou chaîne de traitement:**

**Attribut bas niveau ( mouvement apparent plus restreint)**

**Elaboration du message: filtrage du scintillement, parties d'objet plus grandes**

**Notion de sortie, c.a.d. connections avec régions non visuelles**

### **2 recouvrement entre traitement forme et mouvement:**

**artefact? Attention**

**correspond aux régions impliquées dans l'extraction de la forme 3D du mouvement**

### **3 Certainne spécialisation dorsale ventrale: grande partie du ventral que la forme statique**

