DISCONTINUITES DANS L'IMAGE RETINIENNE :
SEGMENTATION ET ANALYSE DES FORMES PLANES

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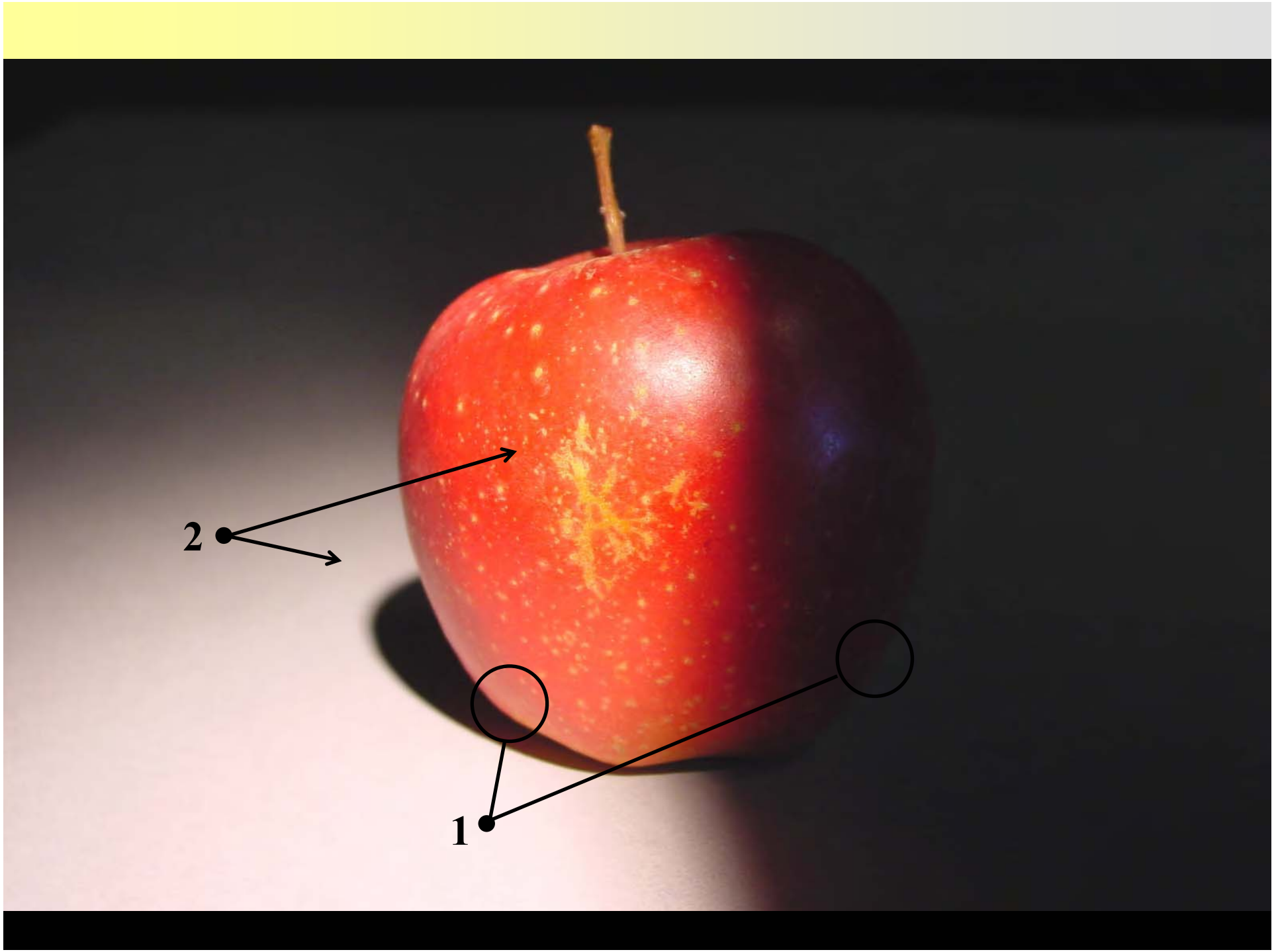
Chaire européenne 2006-2007

Cours 5

COLLÈGE DE FRANCE
1530

KATHOLIEKE UNIVERSITEIT LEUVEN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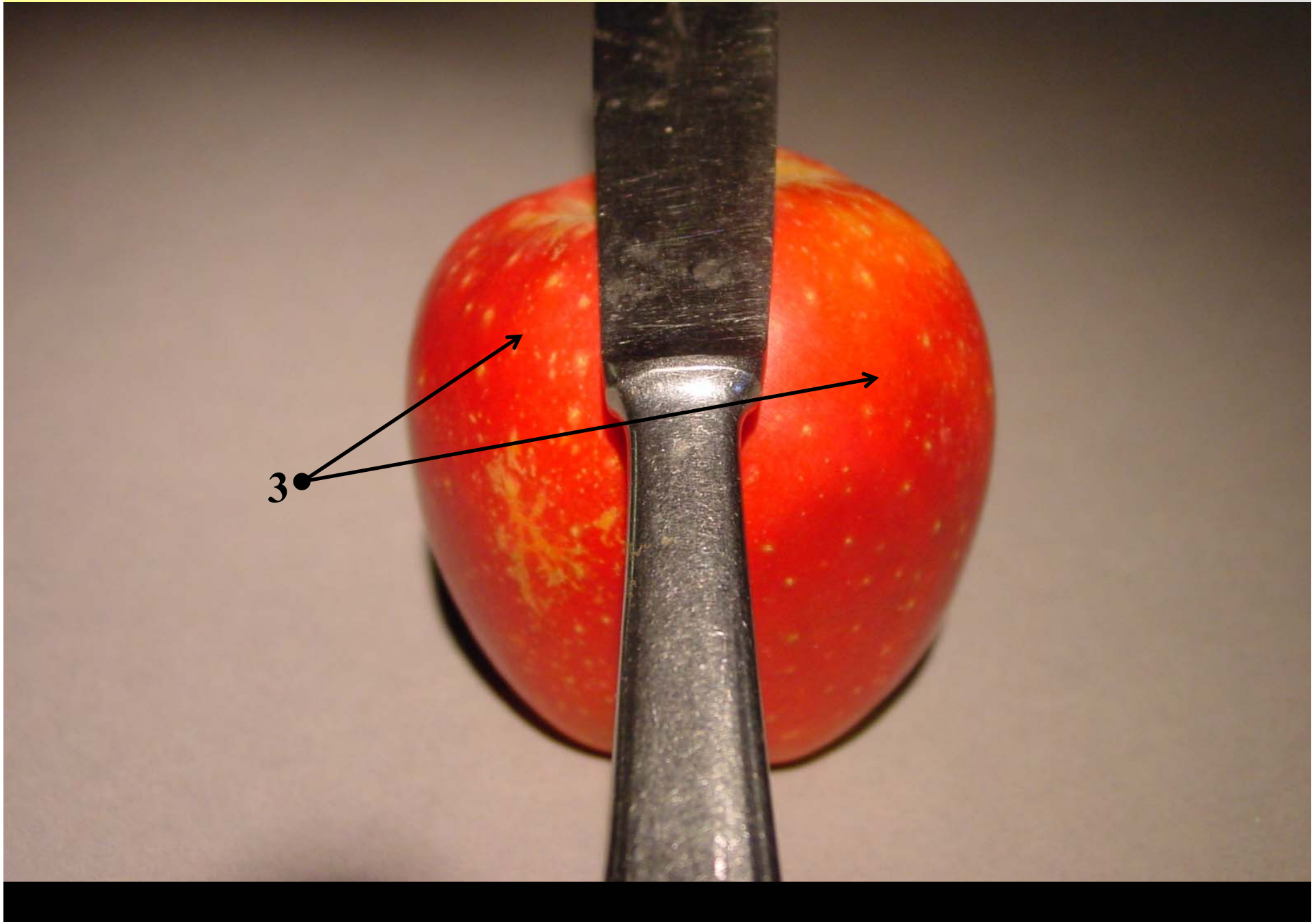
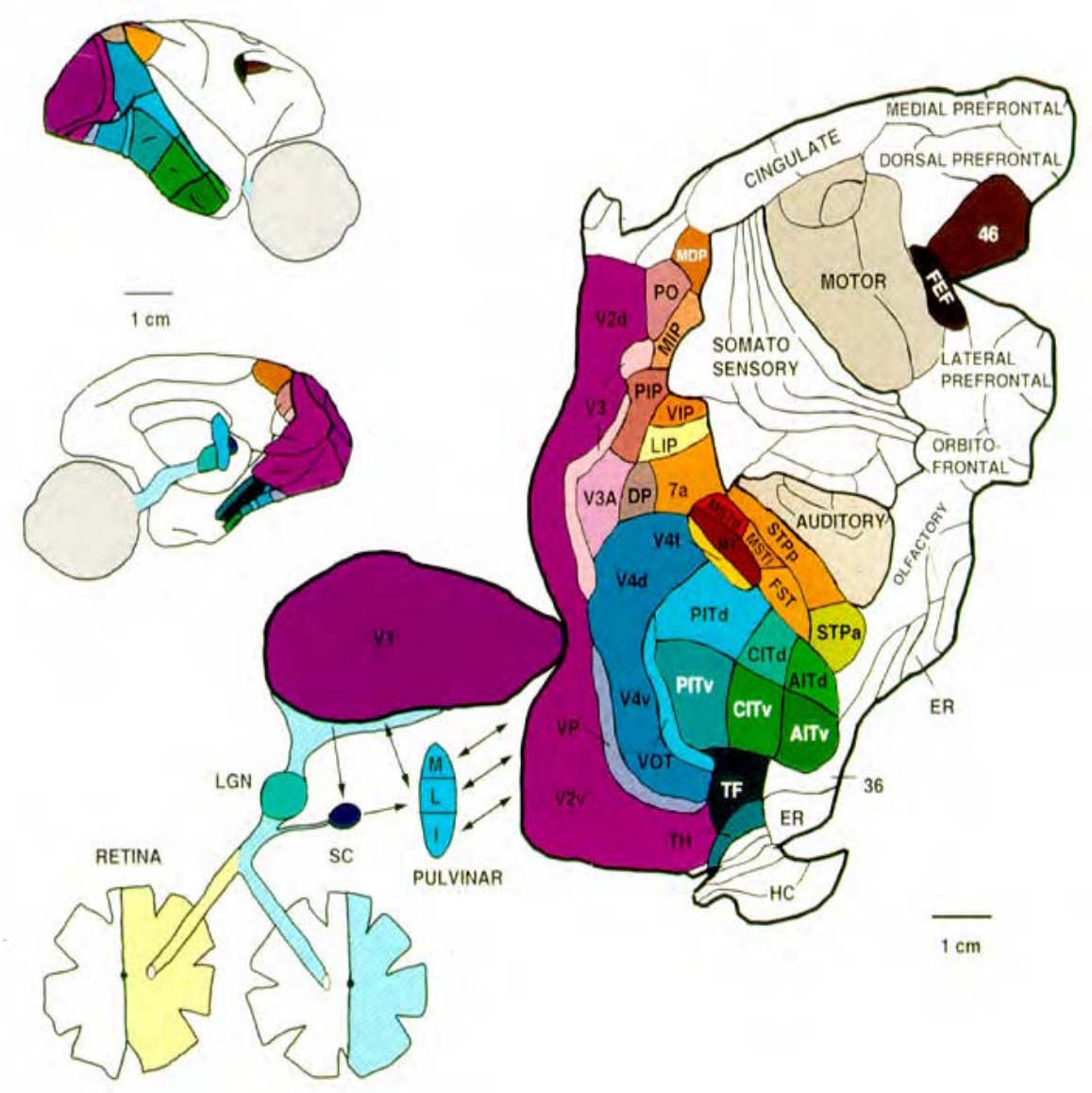
1


3

Limitation du schéma extrastrié



Segmentation: Quelle partie de l'image correspond a un objet
(préalable à l'analyse en vue d'identification)

Le cerveau doit résoudre trois problèmes

1. extraire le contour extérieur de l'objet dans l'image
2. décider de la partie de l'image qui est à l'intérieur du contour d'objet
3. résoudre les cas d'occlusion: décider quelles parties, disjointes dans l'image, font partie de l'image du même objet

1-2 : séparation figure-fond

3 : distinction de multiples objets

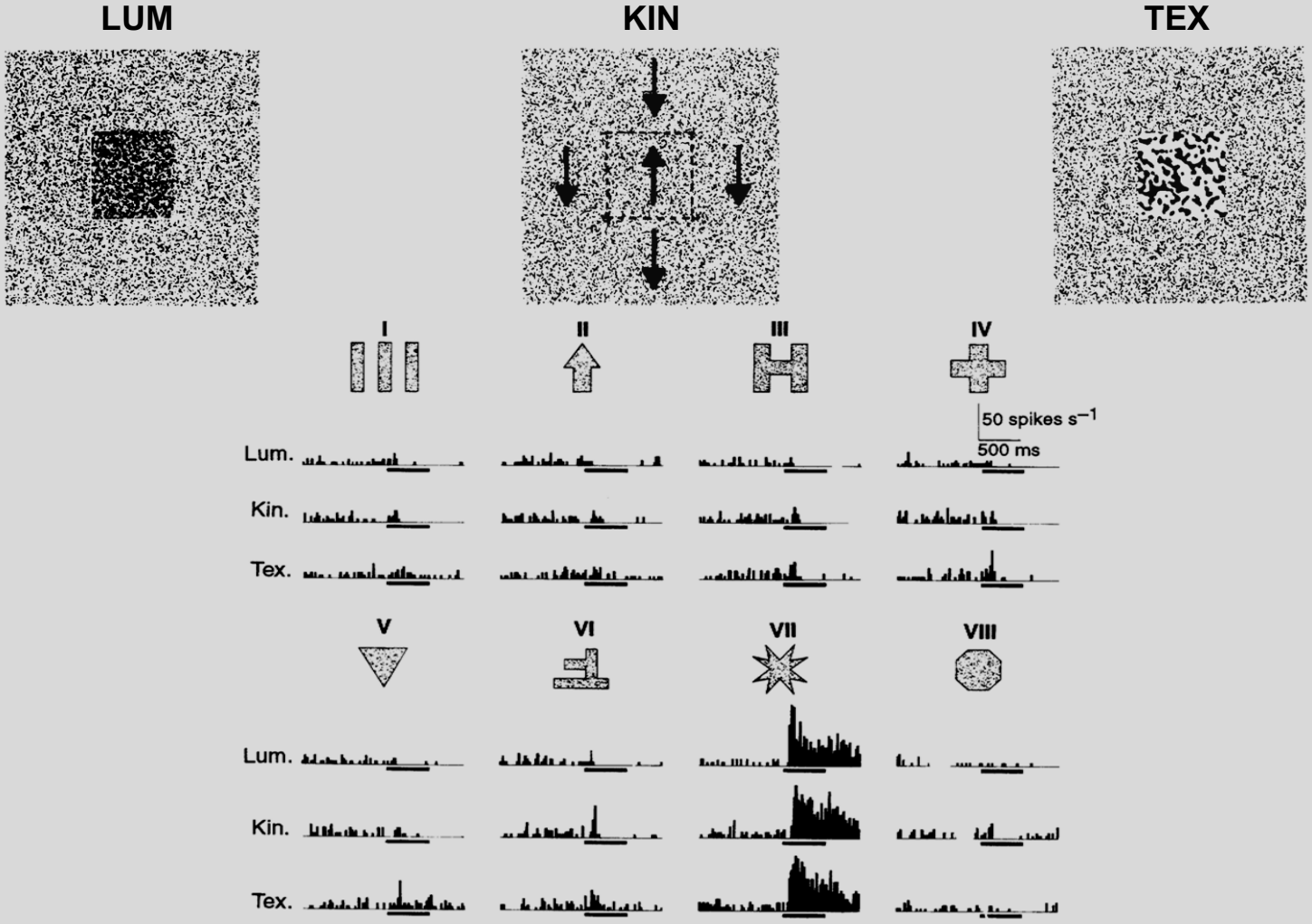
Le cortex extrastrié proche de V1 (V2 et V4) résous le problème 1 :

Solution: extraction de contour basé sur d'autres attributs que la luminance :

Aux bords des objets il a des changements multiples : de luminance, de texture, de profondeur, de couleur etc
Donc plus le système 'sait' (a collecte de l' evidence) qu'il y a des contours définis par de multiples attributs au même endroit, plus il est sur d'avoir extrait un contour extérieur

SEGMENTATION 1: autres contours

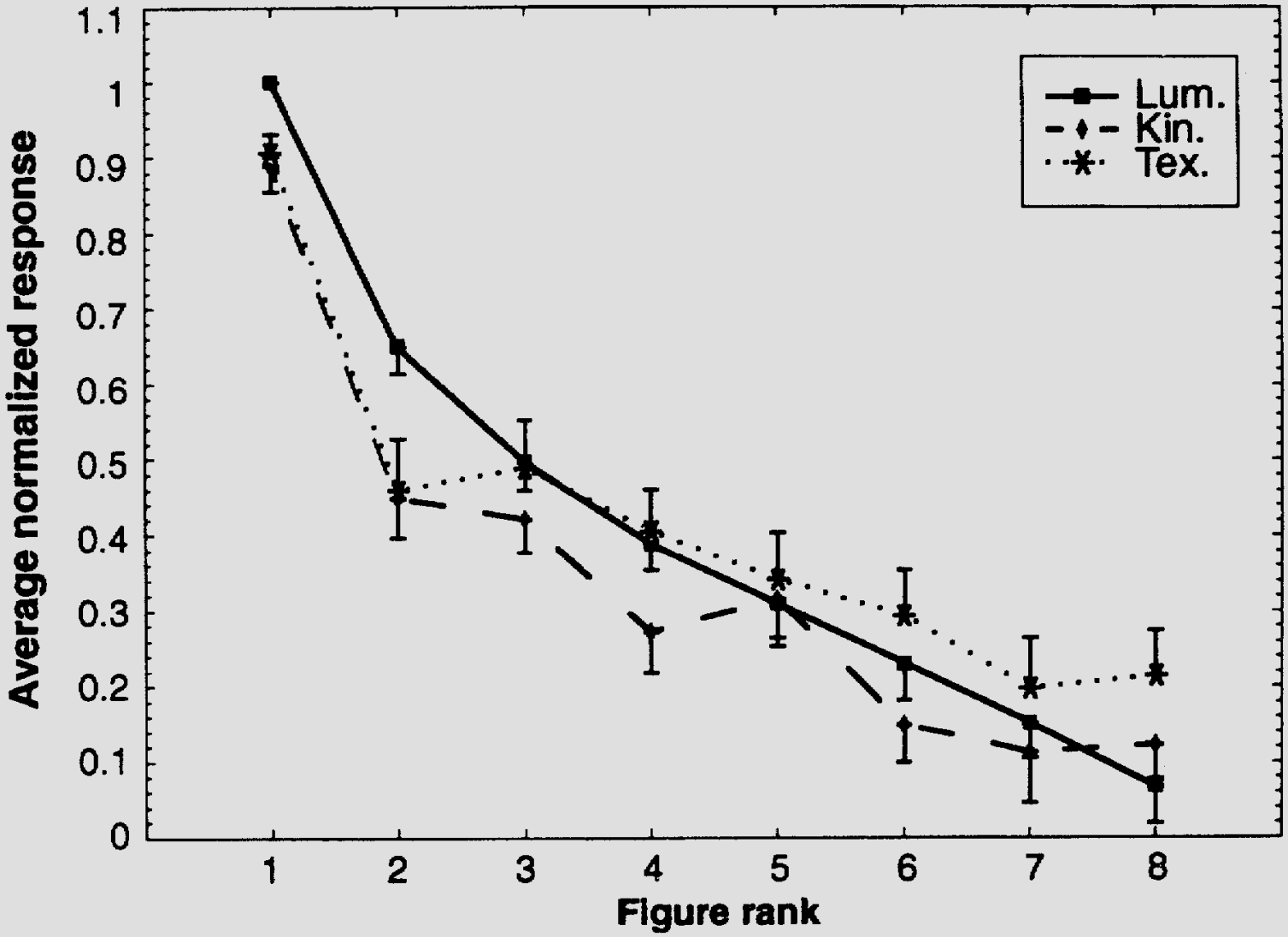
Cortex inféro-temporal
Neurone sélectif pour la forme 2D :
convergence des sources d'information



G. Sary et al, Science, ´93

SEGMENTATION 1: autres contours

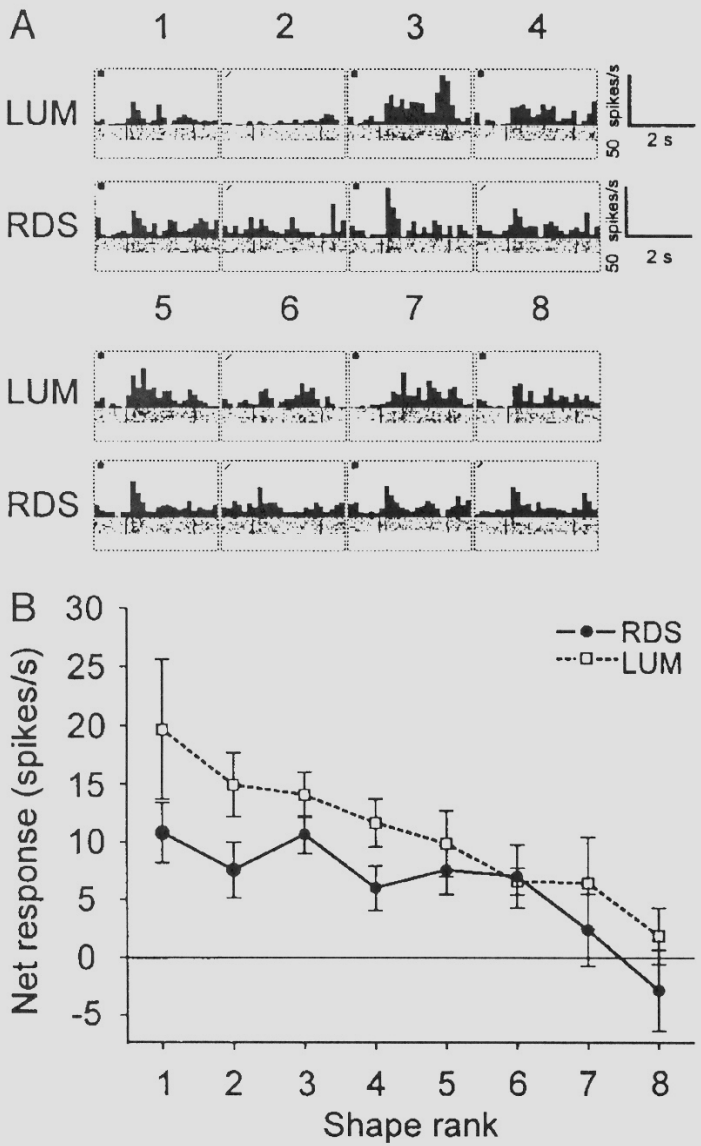
Cortex inféro-temporal



G. Sary et al, Science, ´93

SEGMENTATION 1: autres contours

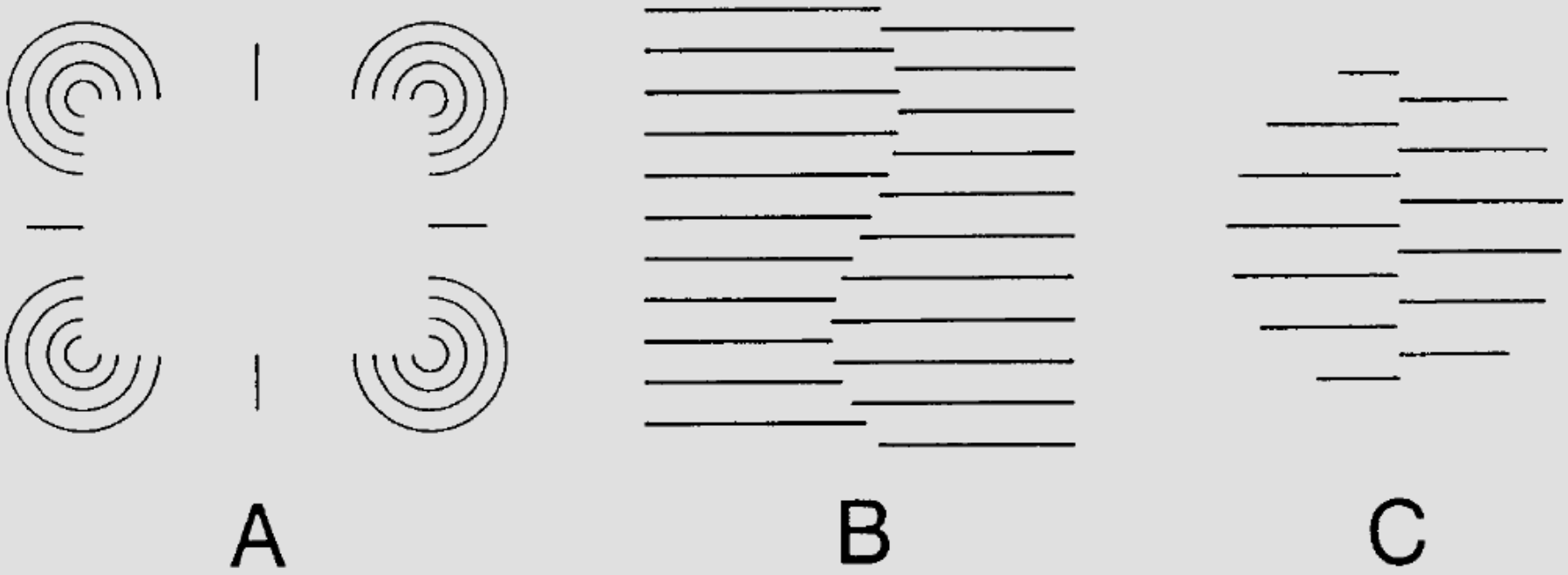
Cortex inféro-temporal



H. Tanaka et al, J. of Neurophys., ´01

SEGMENTATION 1: autres contours

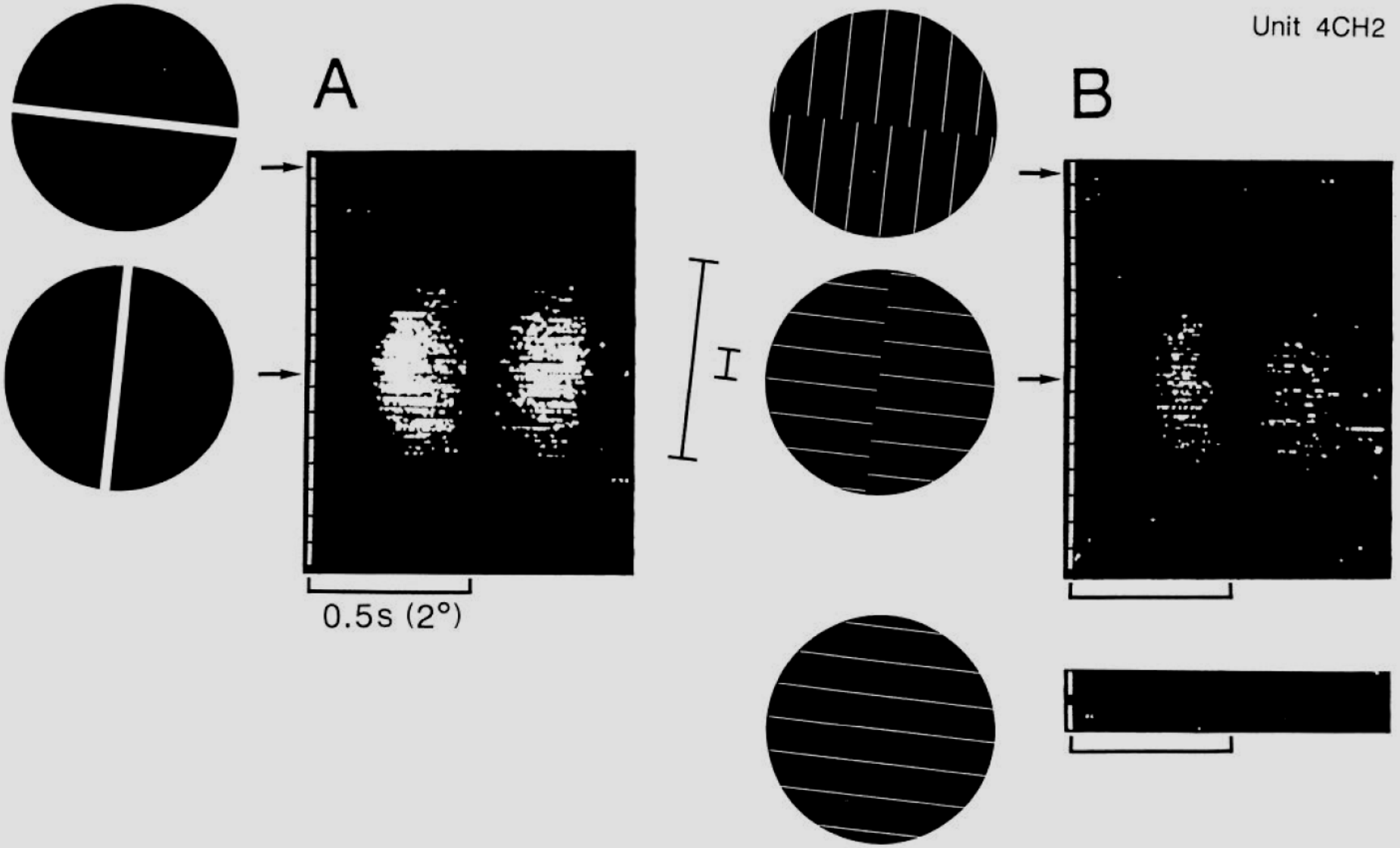
Contours illusoires: V2



R. von der Heydt and E. Peterhans, JoNS, ´89

SEGMENTATION 1: autres contours

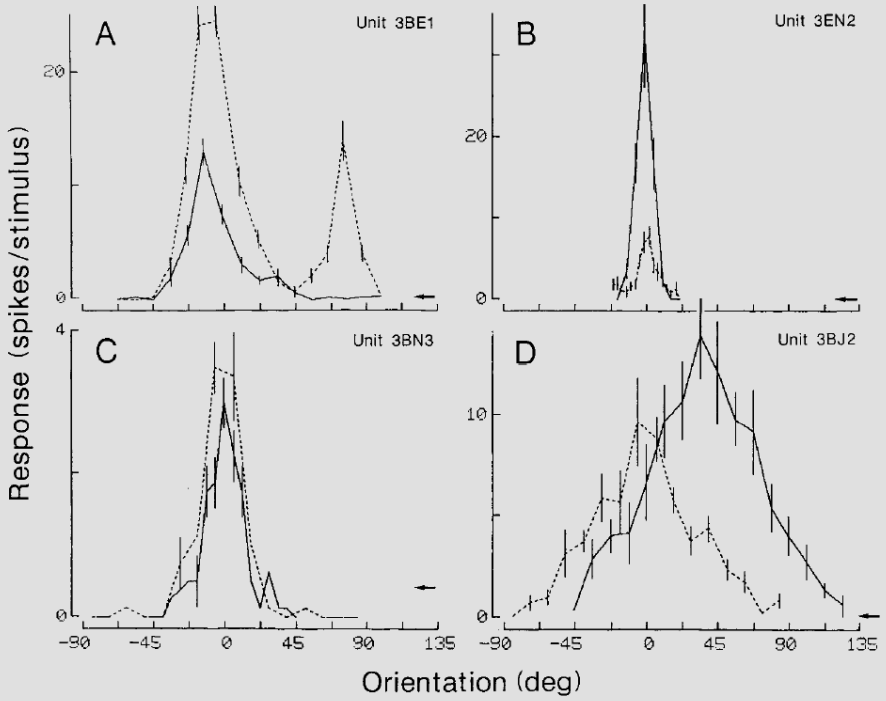
Contours illusoires: V2

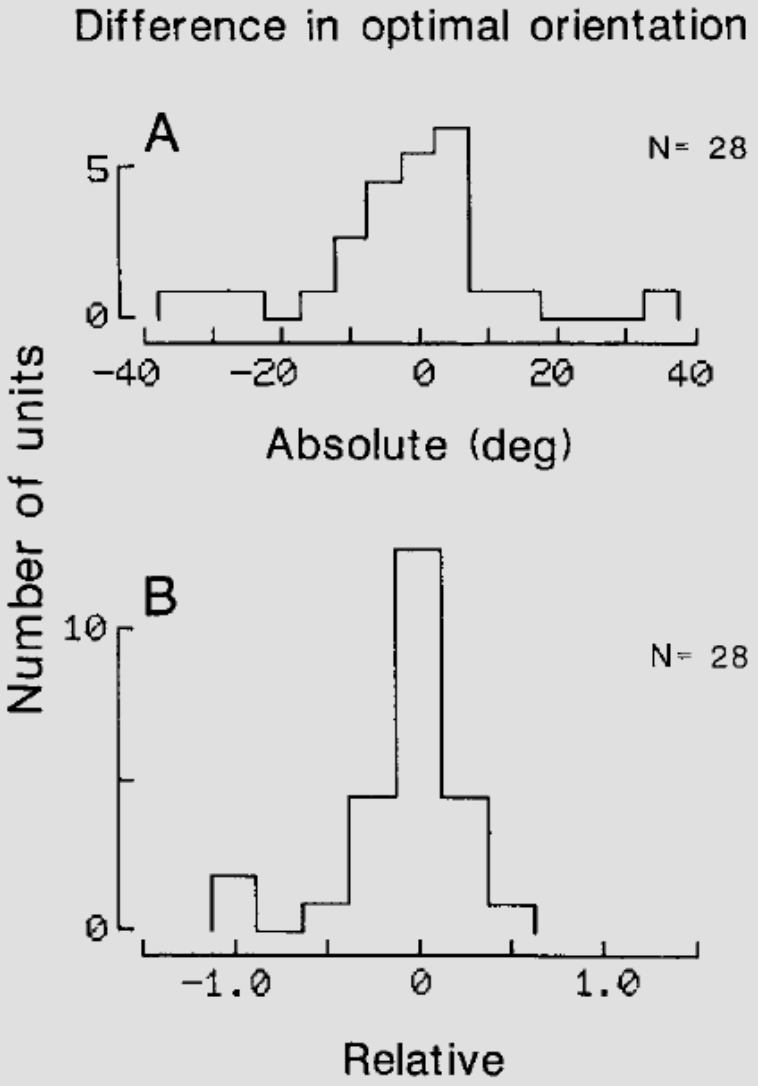


R. von der Heydt and E. Peterhans, JoNS, ´89

SEGMENTATION 1: autres contours

Contours illusoires: V2

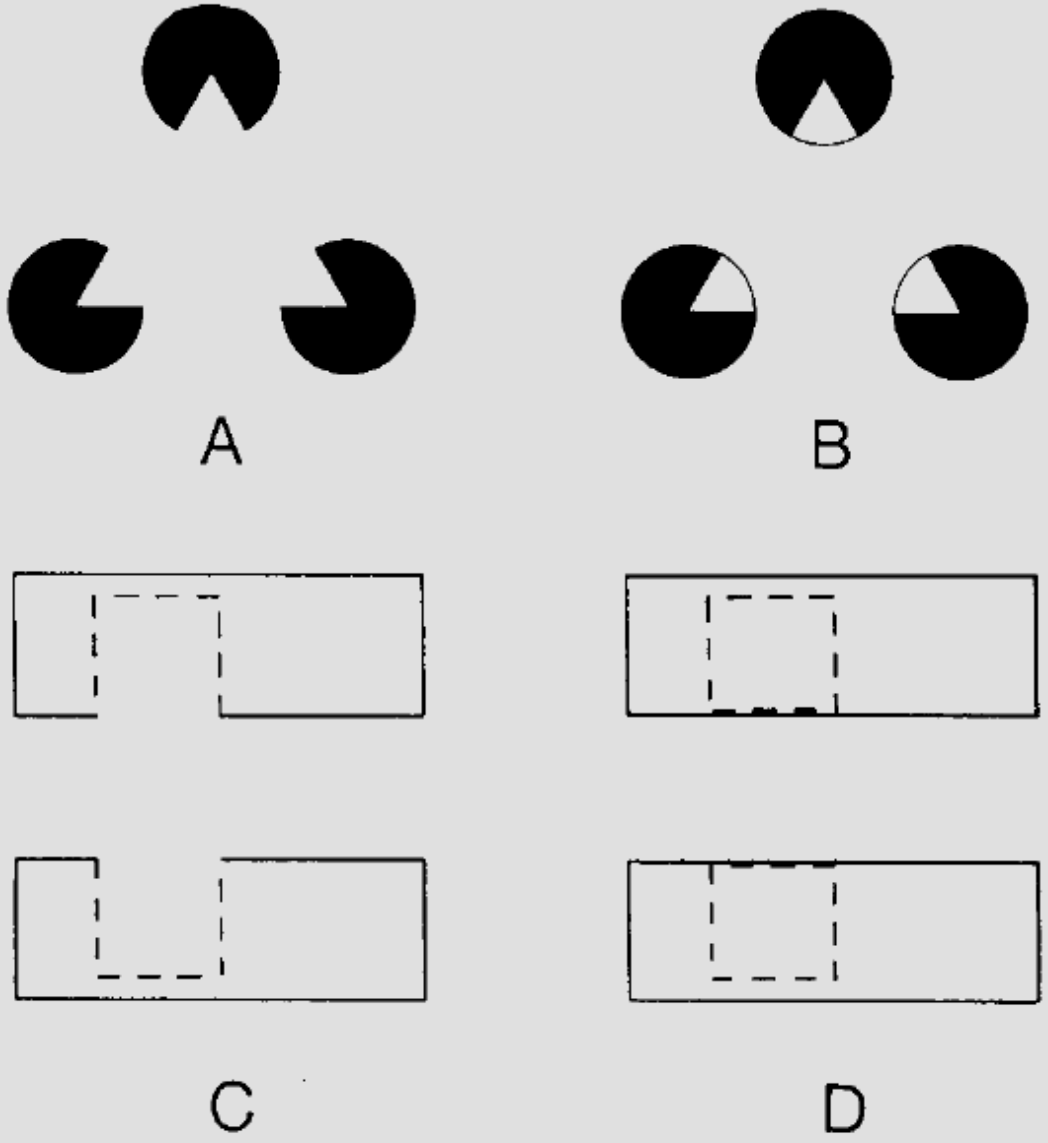




R. von der Heydt and E. Peterhans, JoNS, ´89

SEGMENTATION 1: autres contours

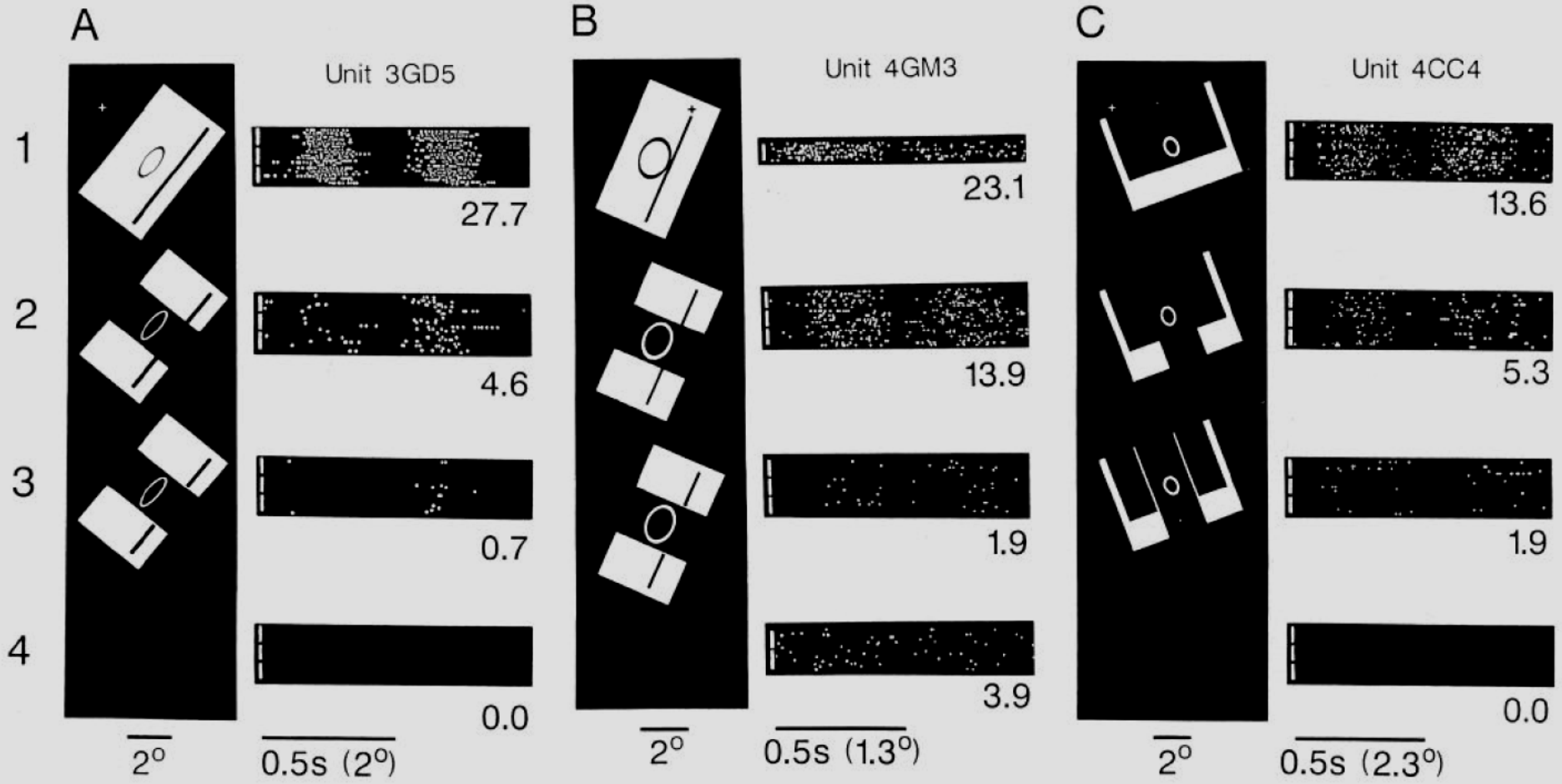
Contours illusoires: V2



E. Peterhans and R. von der Heydt, JoNS, ´89

SEGMENTATION 1: autres contours

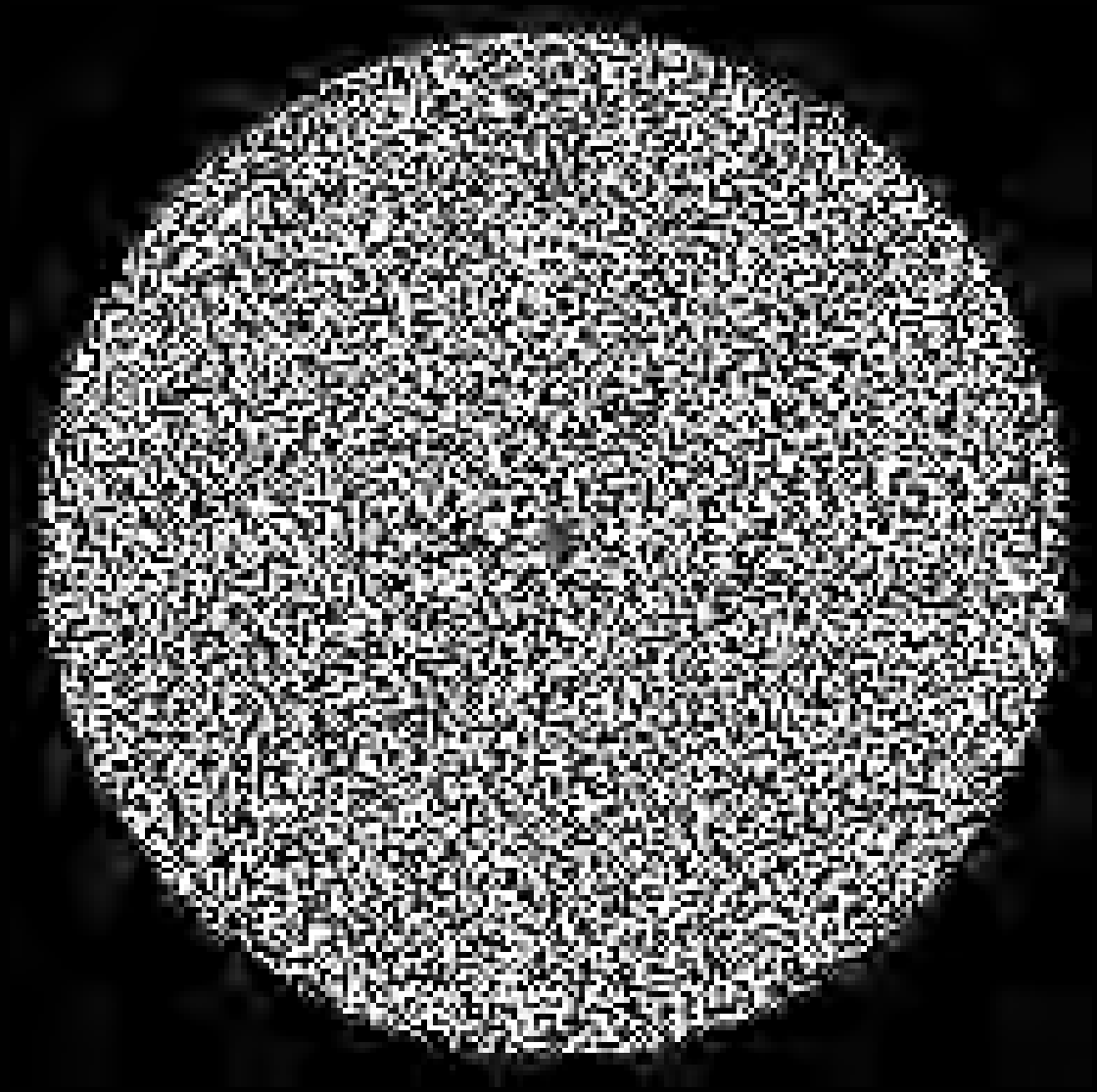
Contours illusoires: V2



E. Peterhans and R. von der Heydt, JoNS, ´89

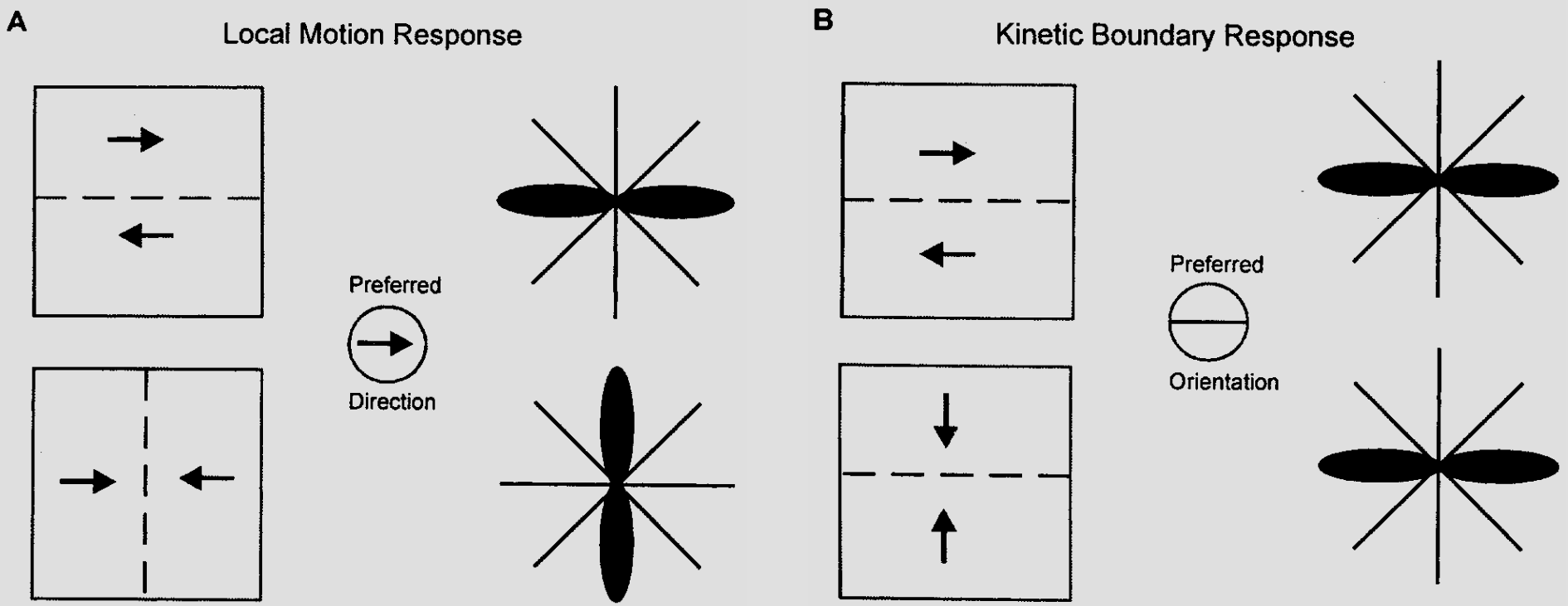
SEGMENTATION 1: autres contours

Contours cinétiques: MT/V5



SEGMENTATION 1: autres contours

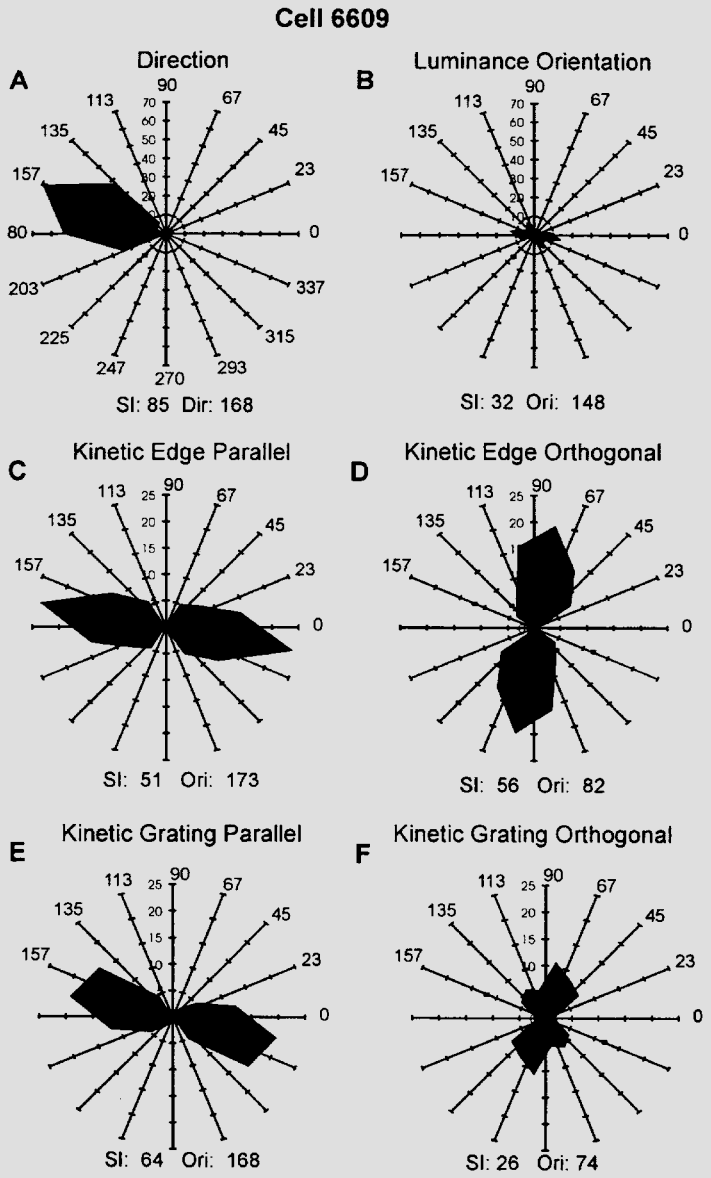
Contours cinétiques: MT/V5



V. Marcar et al, J. of Neurophys., ´95

SEGMENTATION 1: autres contours

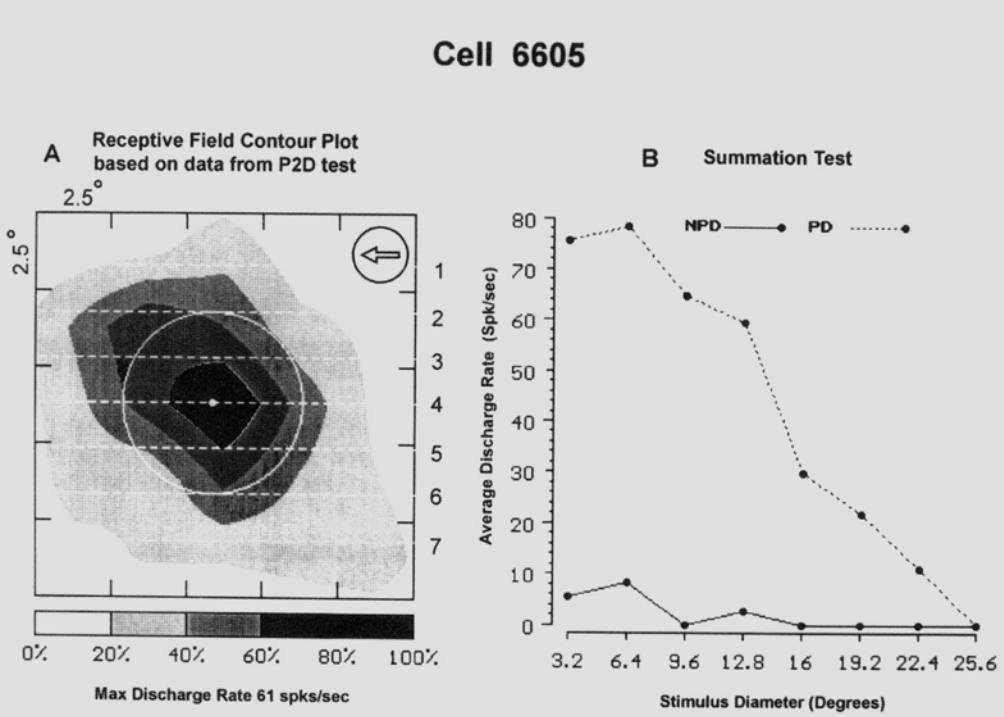
Contours cinétiques: MT/V5

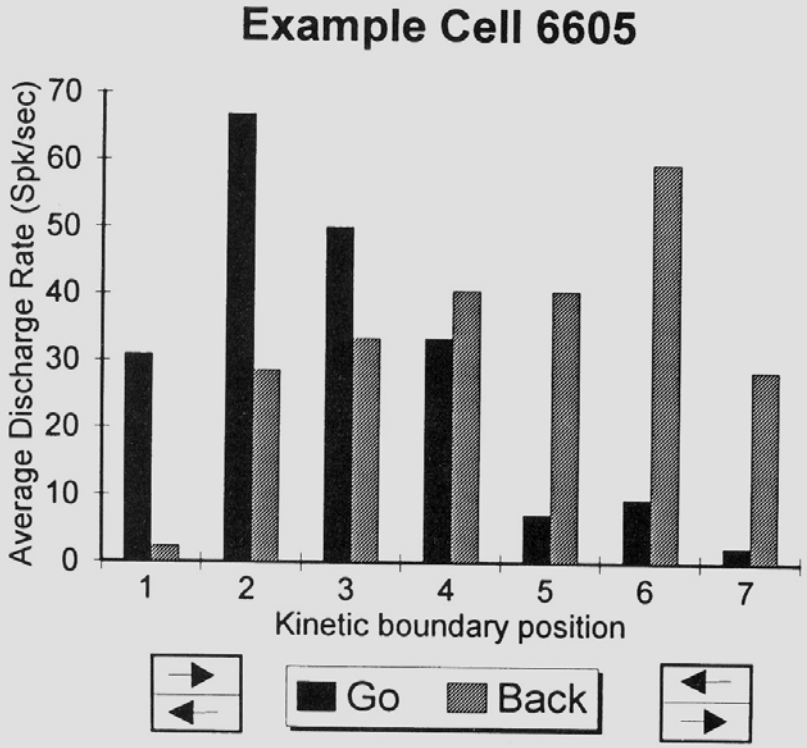


V. Marcar et al, J. of Neurophys., ´95

SEGMENTATION 1: autres contours

Contours cinétiques: MT/V5

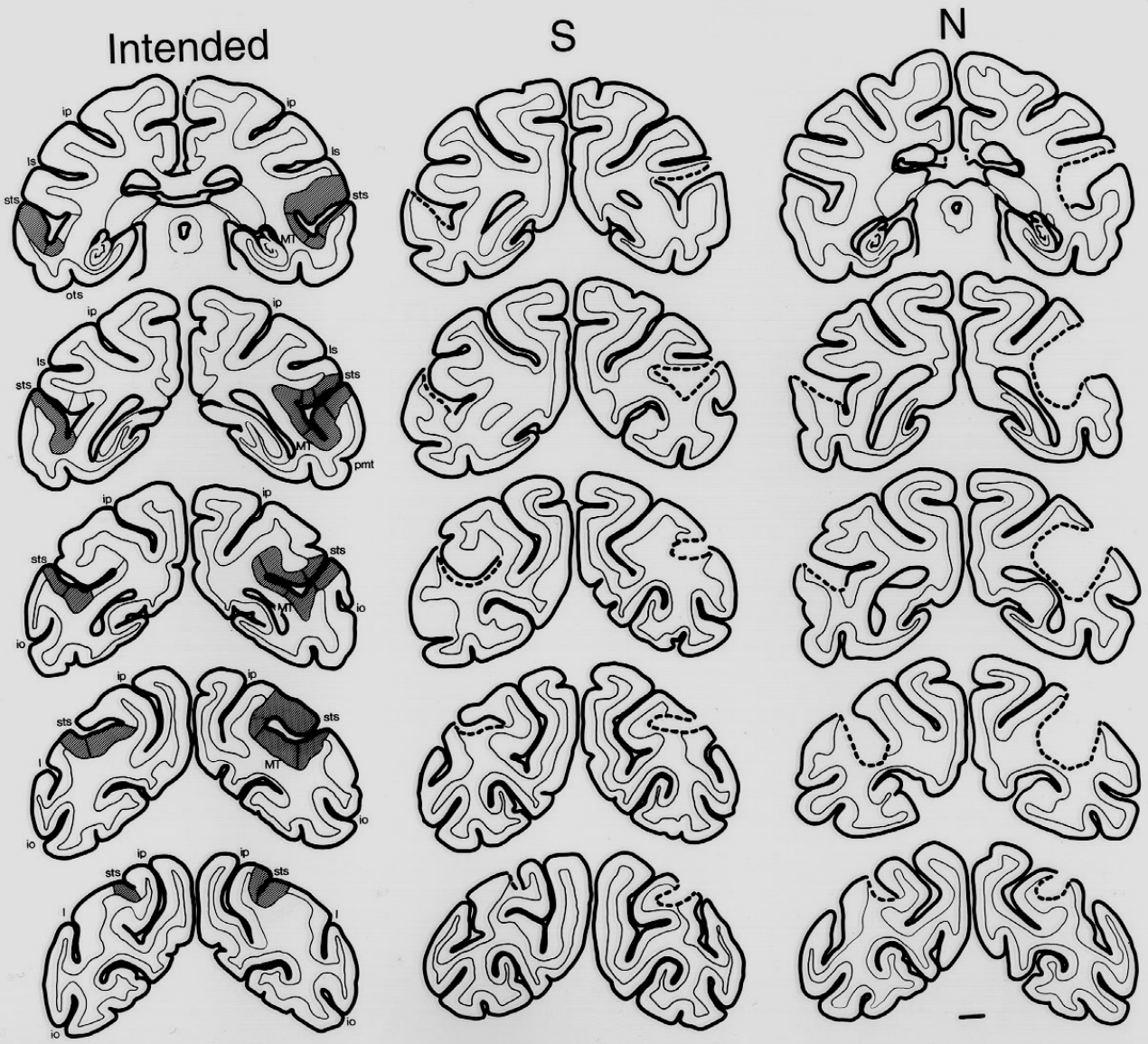




V. Marcar et al, J. of Neurophys., ´95

SEGMENTATION 1: autres contours

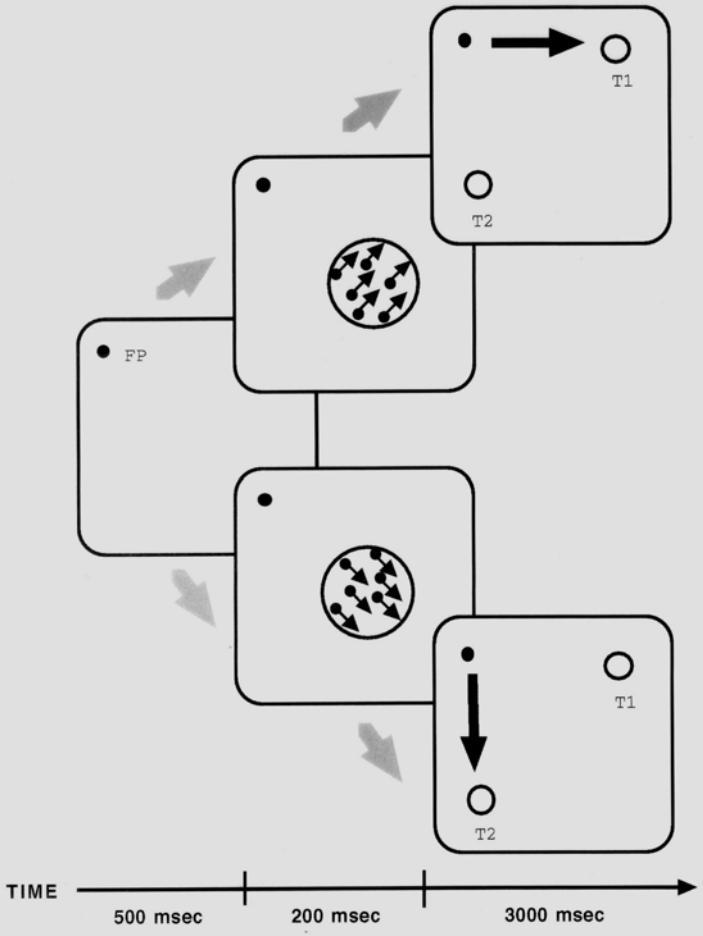
Contours cinétiques: MT/V5

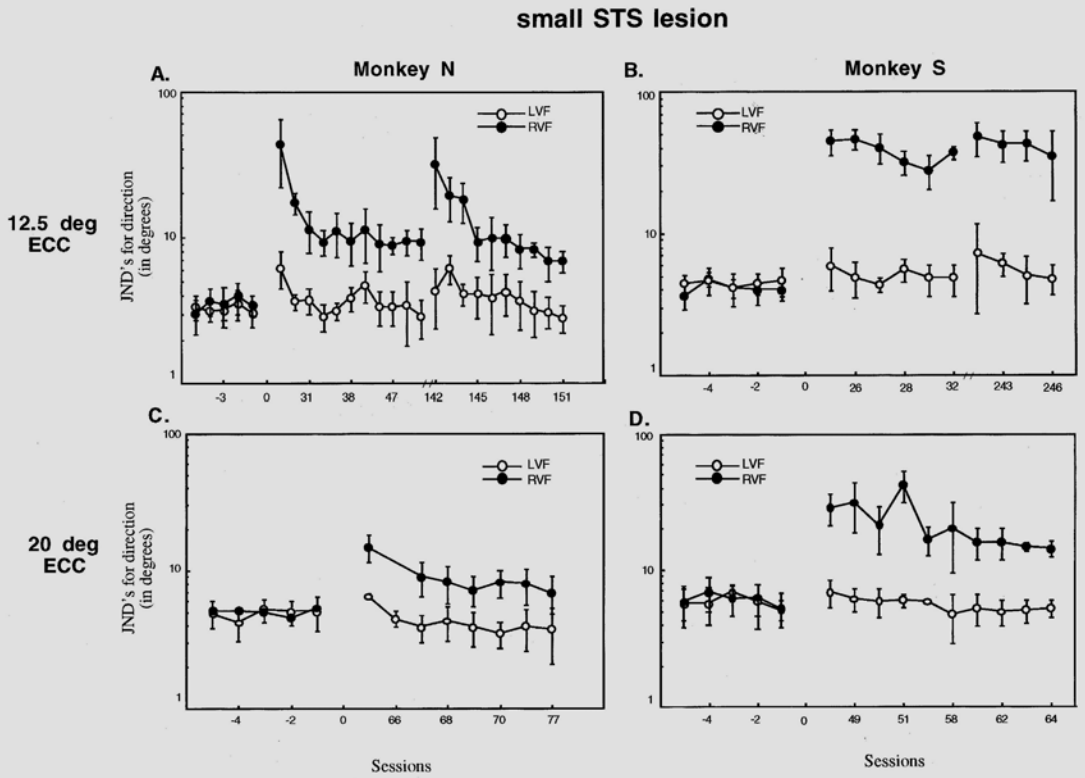


K. Lauwers et al, J. of Comp. Neurology., ´95

SEGMENTATION 1: autres contours

Contours cinétiques: MT/V5

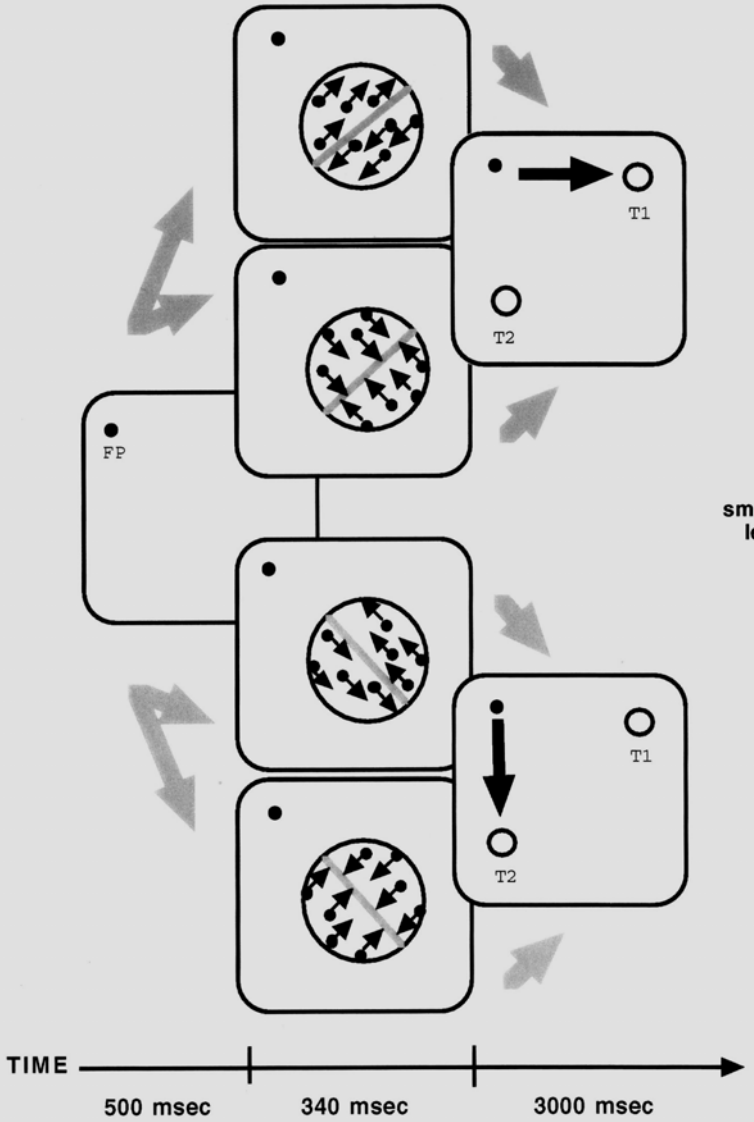


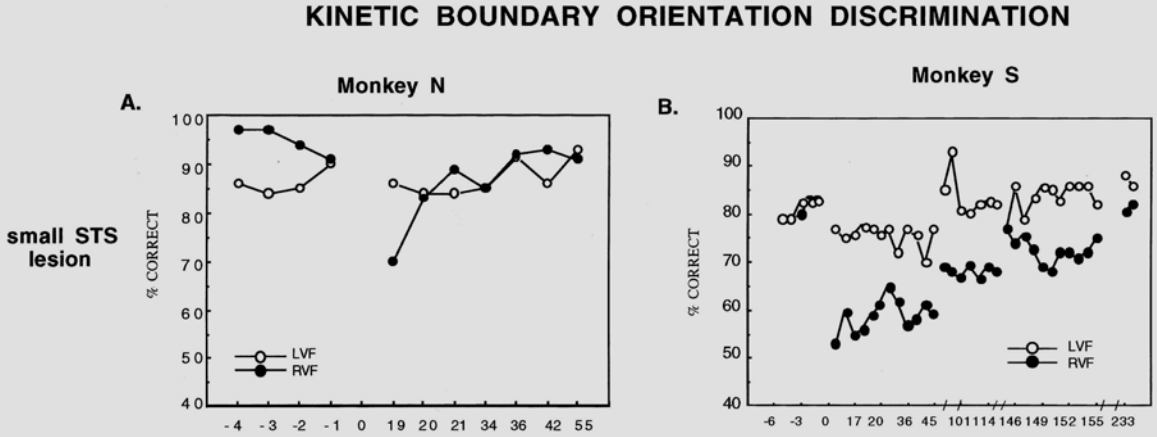


K. Lauwers et al, J. of Comp. Neurology., ´95

SEGMENTATION 1: autres contours

Contours cinétiques: MT/V5

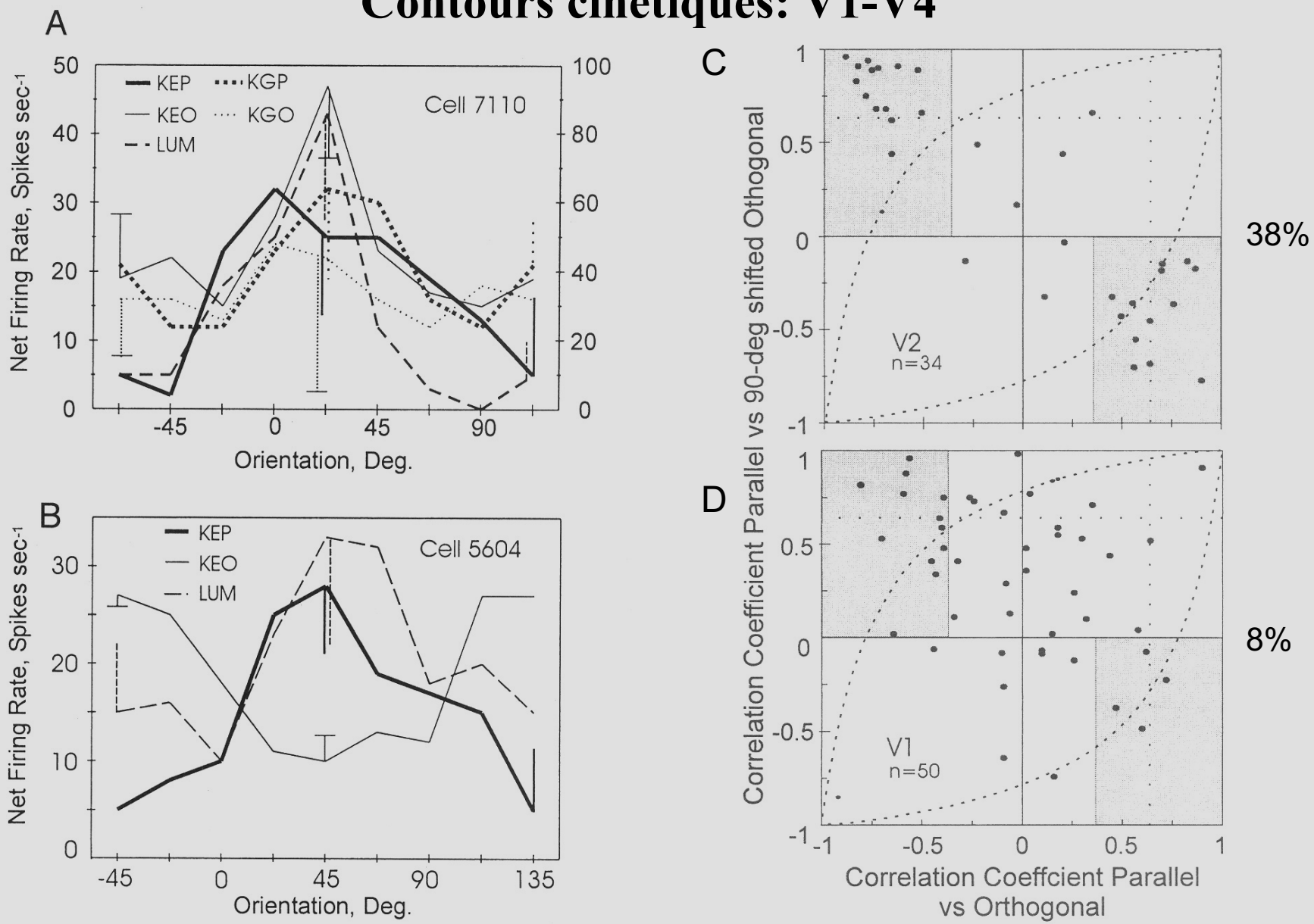




K. Lauwers et al, J. of Comp. Neurology., ´95

SEGMENTATION 1: autres contours

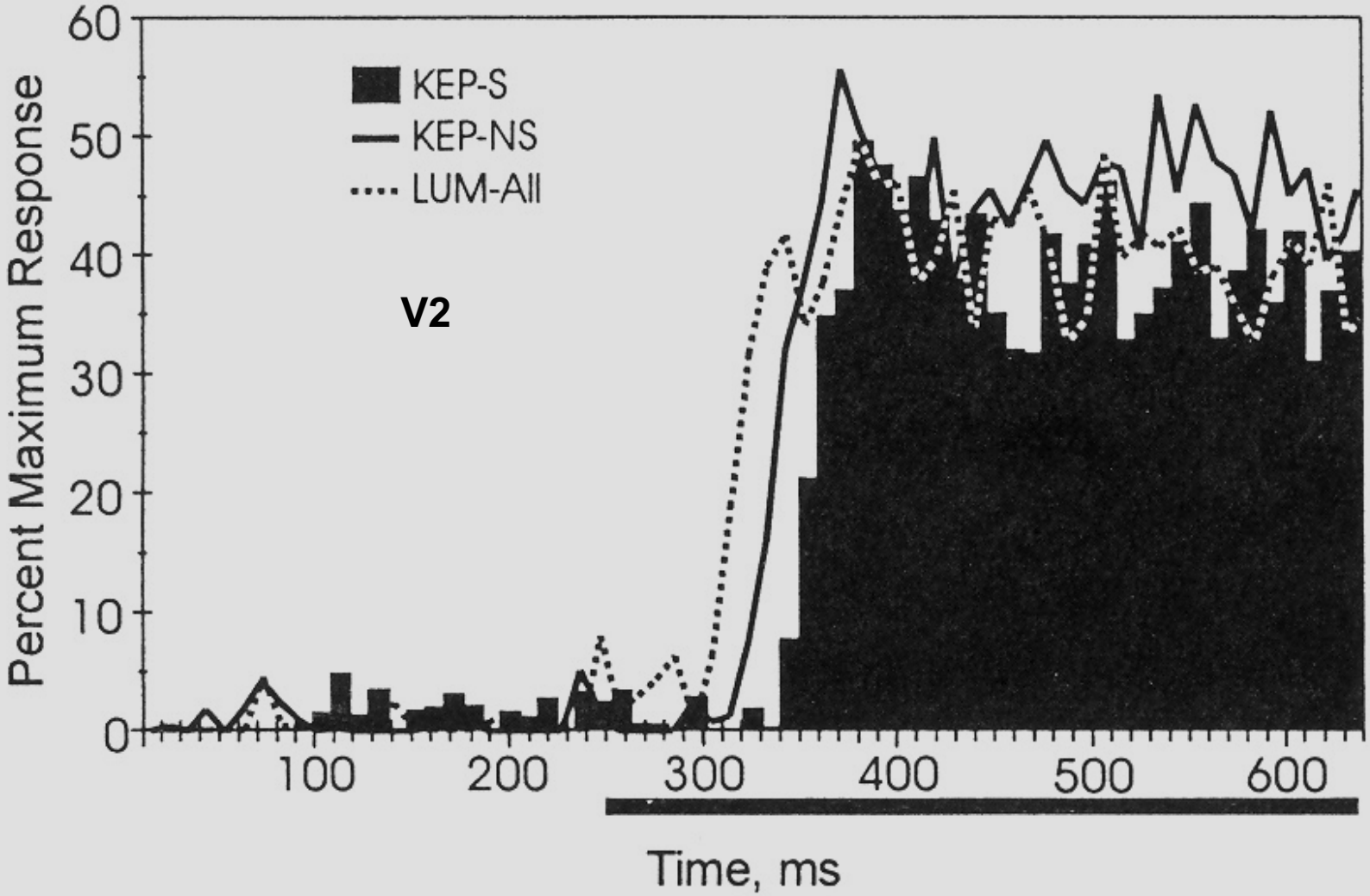
Contours cinétiques: V1-V4



V. Marcar et al, J. of Neurophys., ´00

SEGMENTATION 1: autres contours

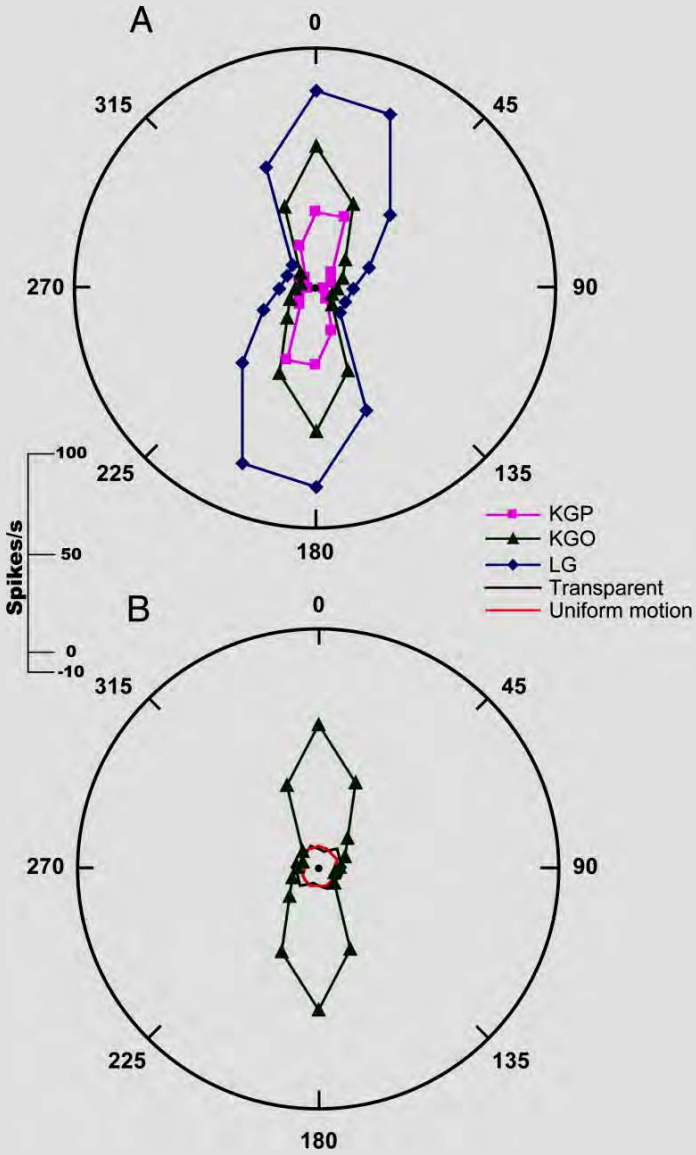
Contours cinétiques: V1-V4

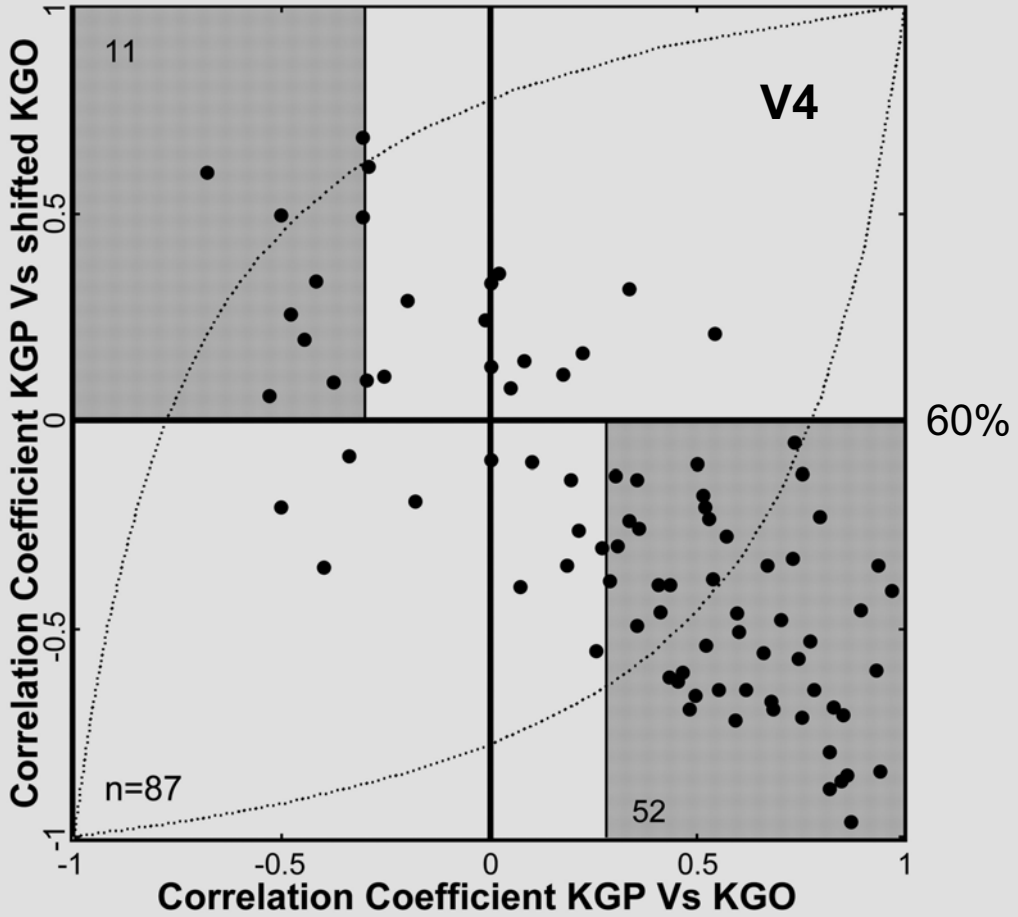


V. Marcar et al, J. of Neurophys., ´00

SEGMENTATION 1: autres contours

Contours cinétiques: V1,V2,V4



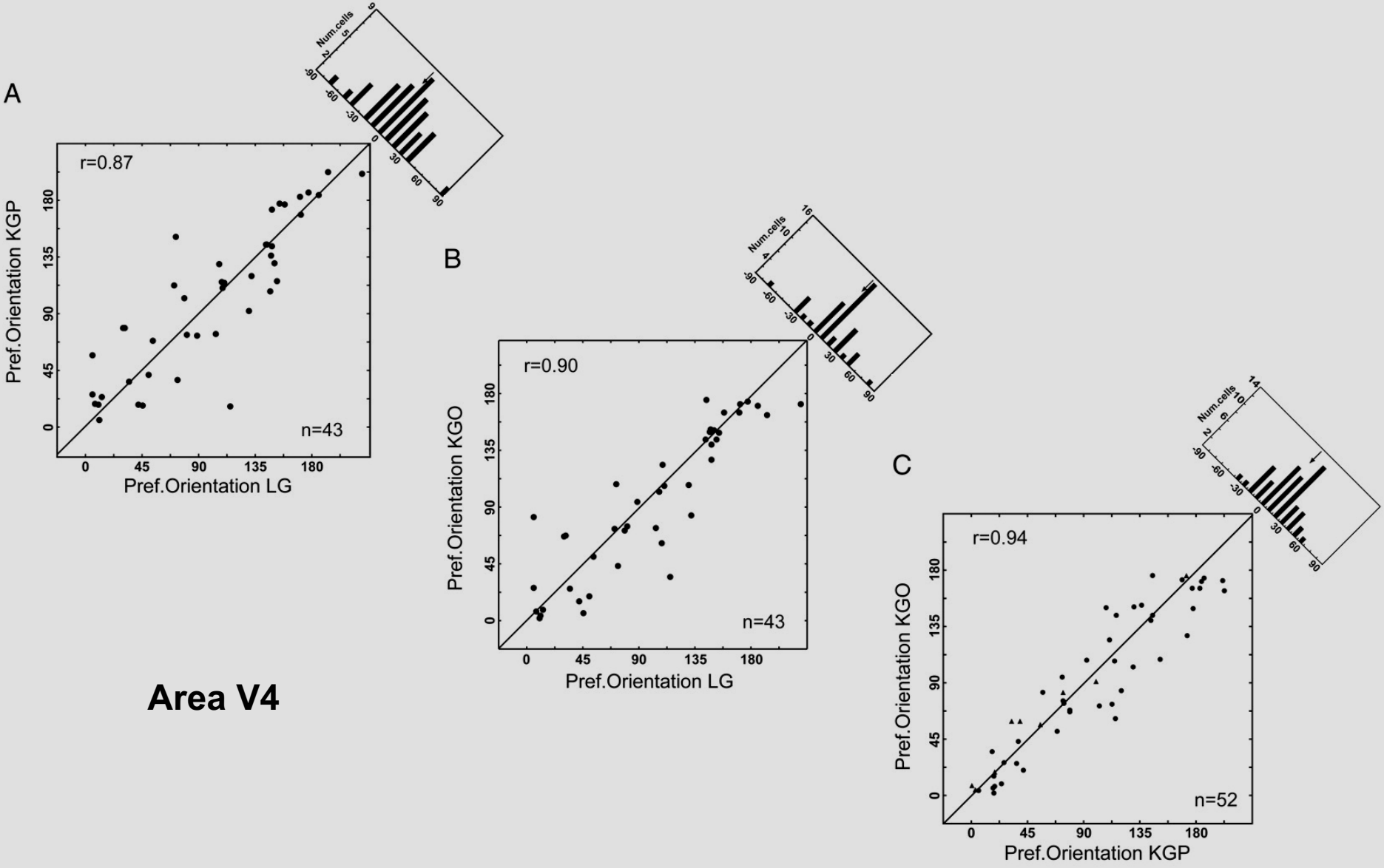


60%

S. Mysore et al, J. of Neurophys., ´06

SEGMENTATION 1: autres contours

Contours cinétiques: V1-V4

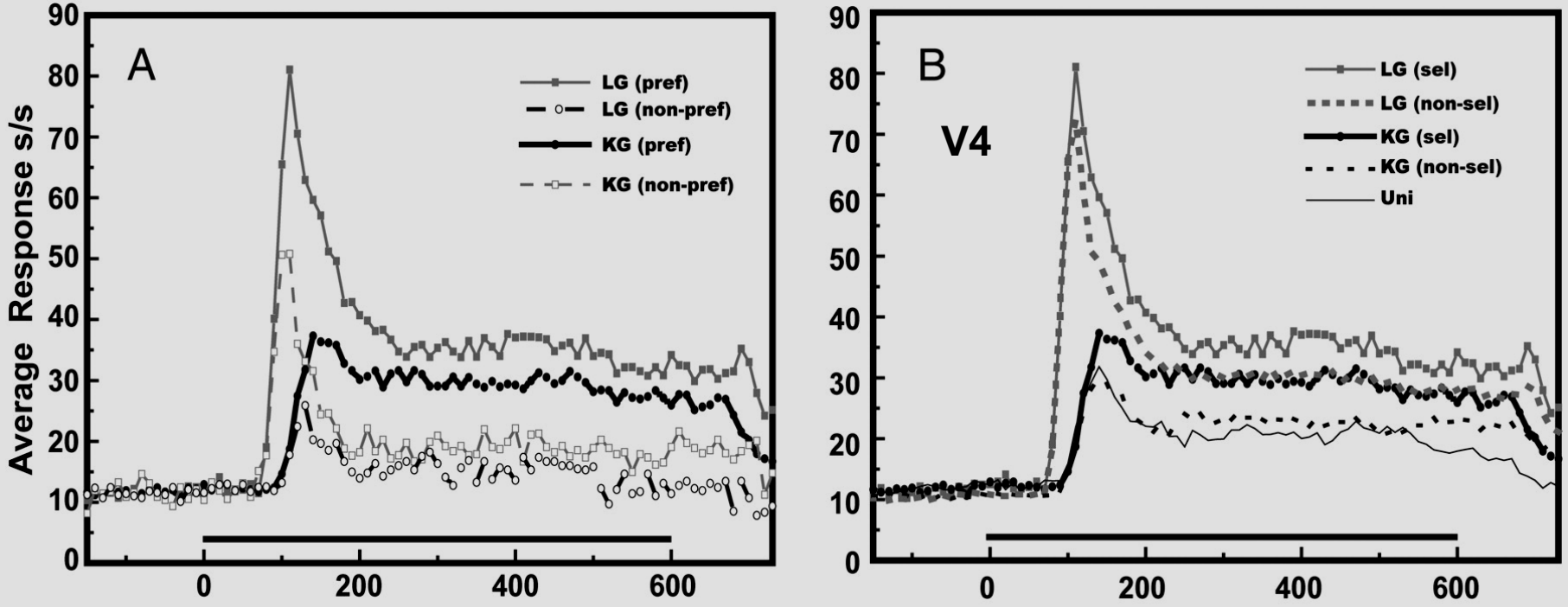


Area V4

S. Mysore et al, J. of Neurophys., ´06

SEGMENTATION 1: autres contours

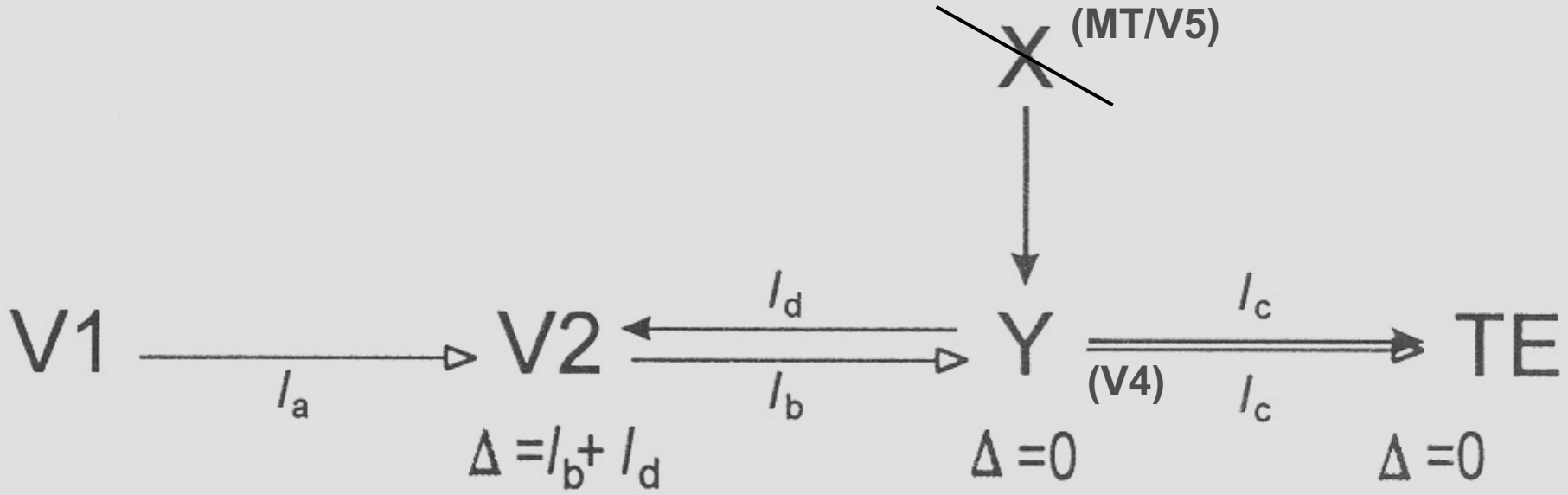
Contours cinétiques: V1-V4



S. Mysore et al, J. of Neurophys., ´06

SEGMENTATION 1: autres contours

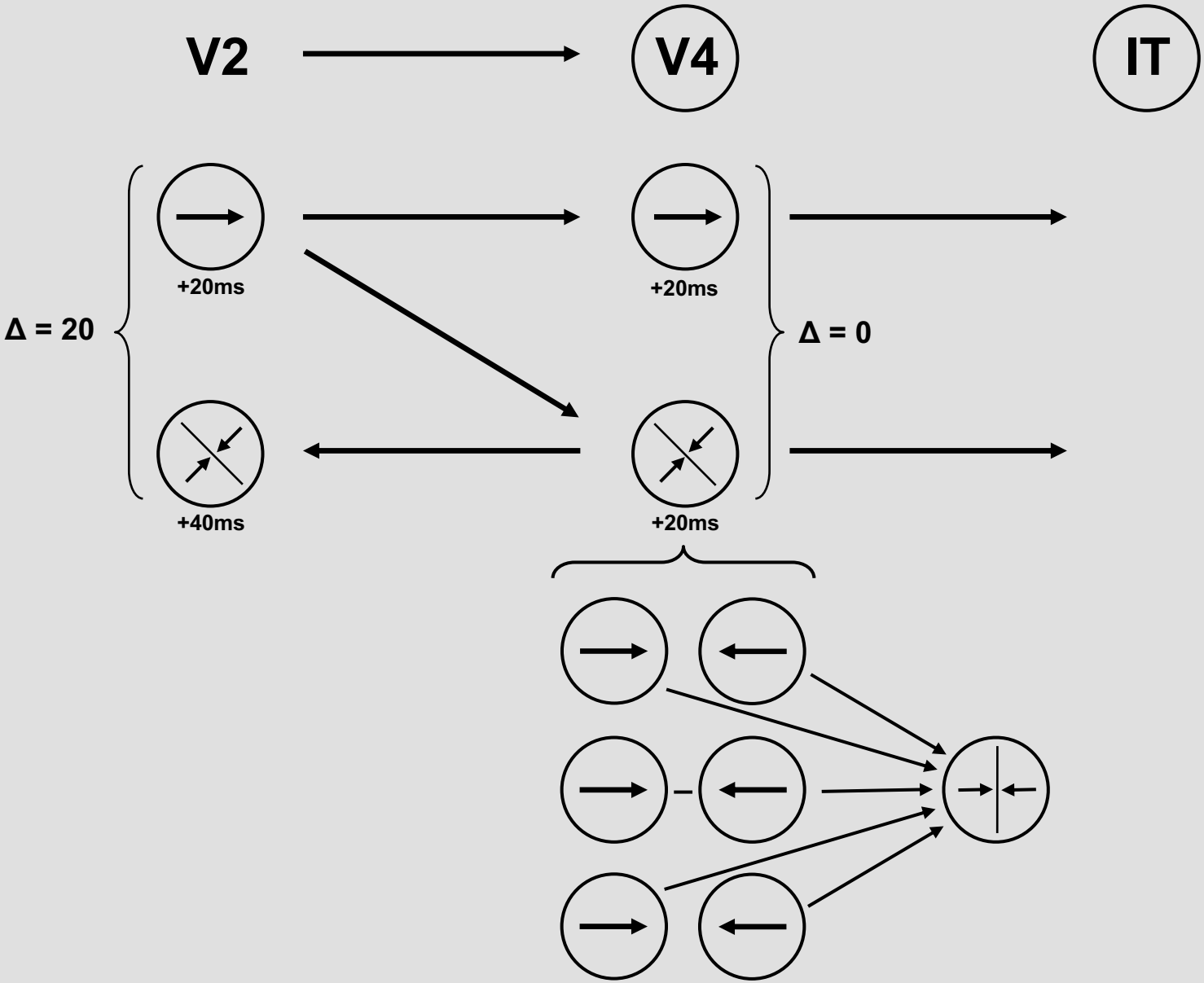
Contours cinétiques: V1-V4



V. Marcar et al, J. of Neurophys., ´00

SEGMENTATION 1: autres contours

Contours cinétiques: V1-V4



SEGMENTATION 2: relation figure - contour

Le cortex extrastrié proche de V1 résous le problème deux sans connaitre tout le contour complet

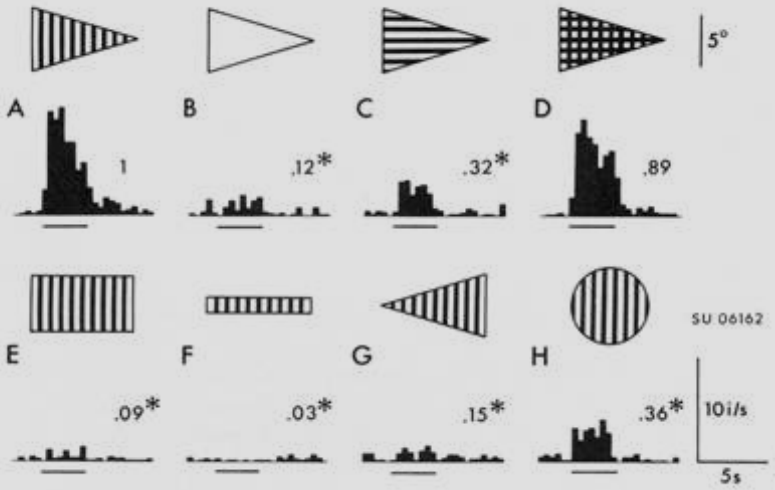
Solution : **1) déterminer localement de quel coté du contour se trouve la figure (définie par luminance) : border ownership**

2) analyser localement les propriétés des surfaces

SEGMENTATION 2: relation figure - contour

Neurones inféro-temporaux : convergence de forme 2D, texture et couleur

Cell 1



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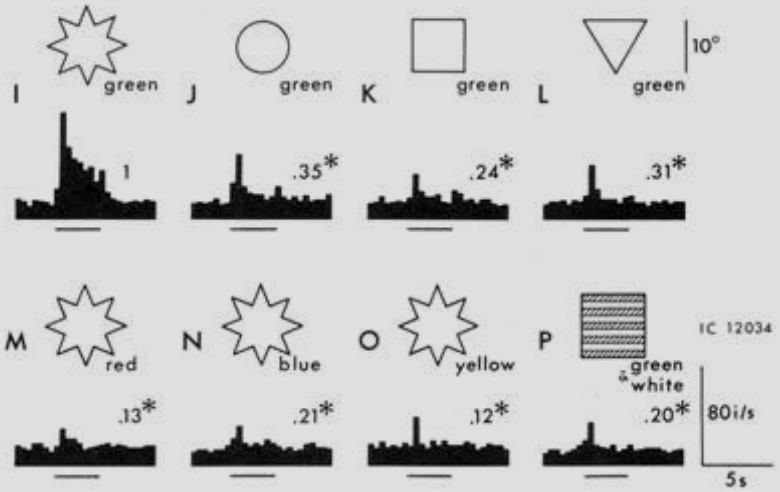

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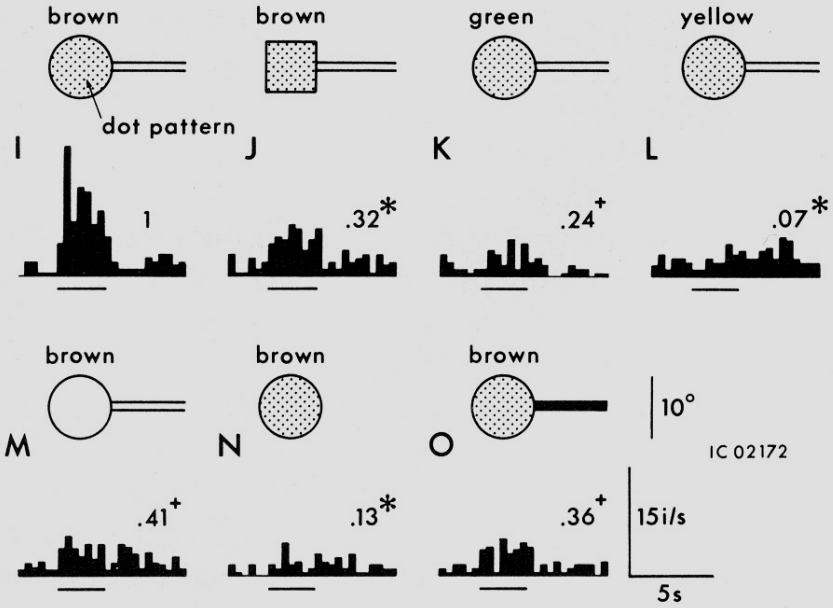
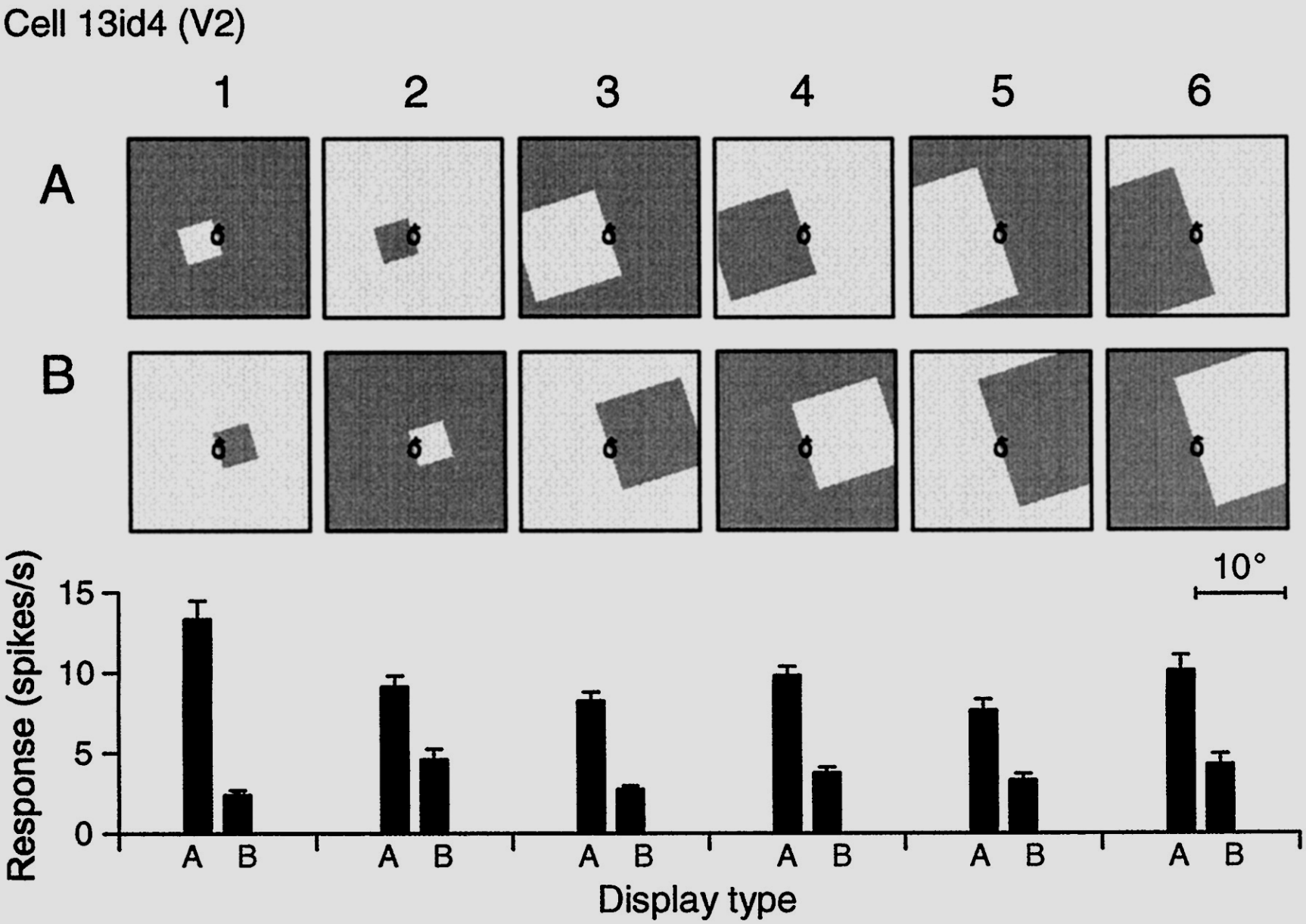


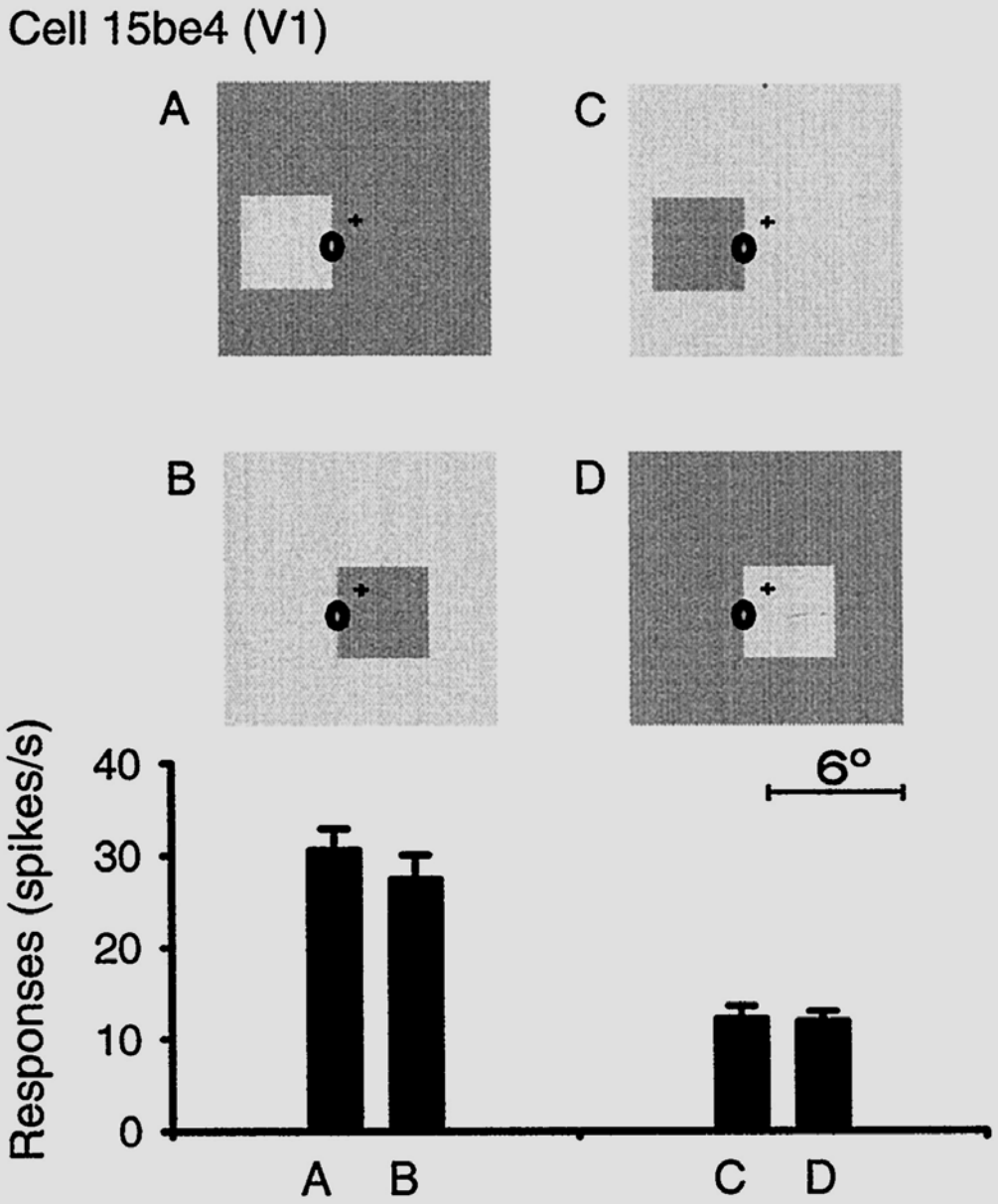
H. Tanaka, et al. J. of Neurophys., ´91

SEGMENTATION 2: relation figure - contour



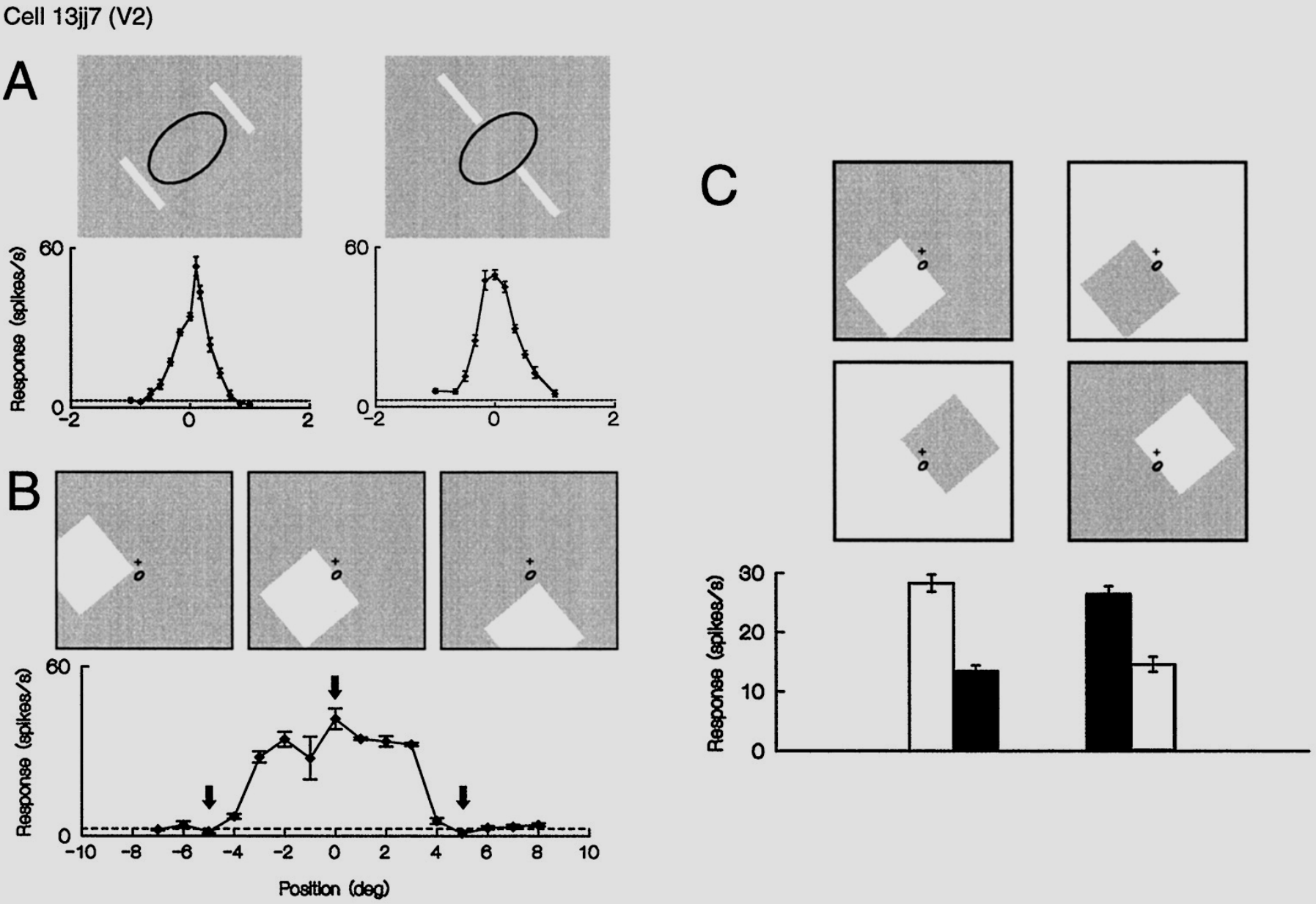
H. Zou et al, JoNS, ´00

SEGMENTATION 2: relation figure - contour



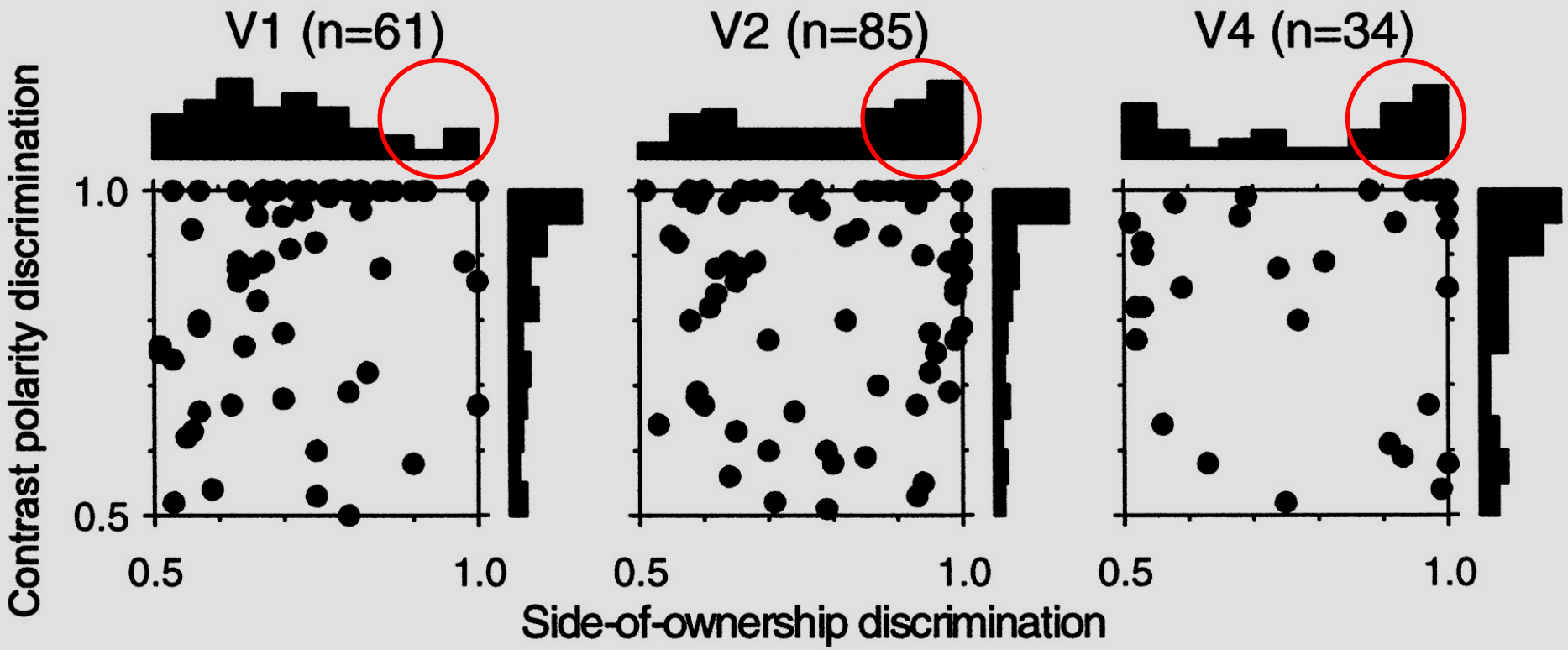
H. Zou et al, JoNS, ´00

SEGMENTATION 2: relation figure - contour

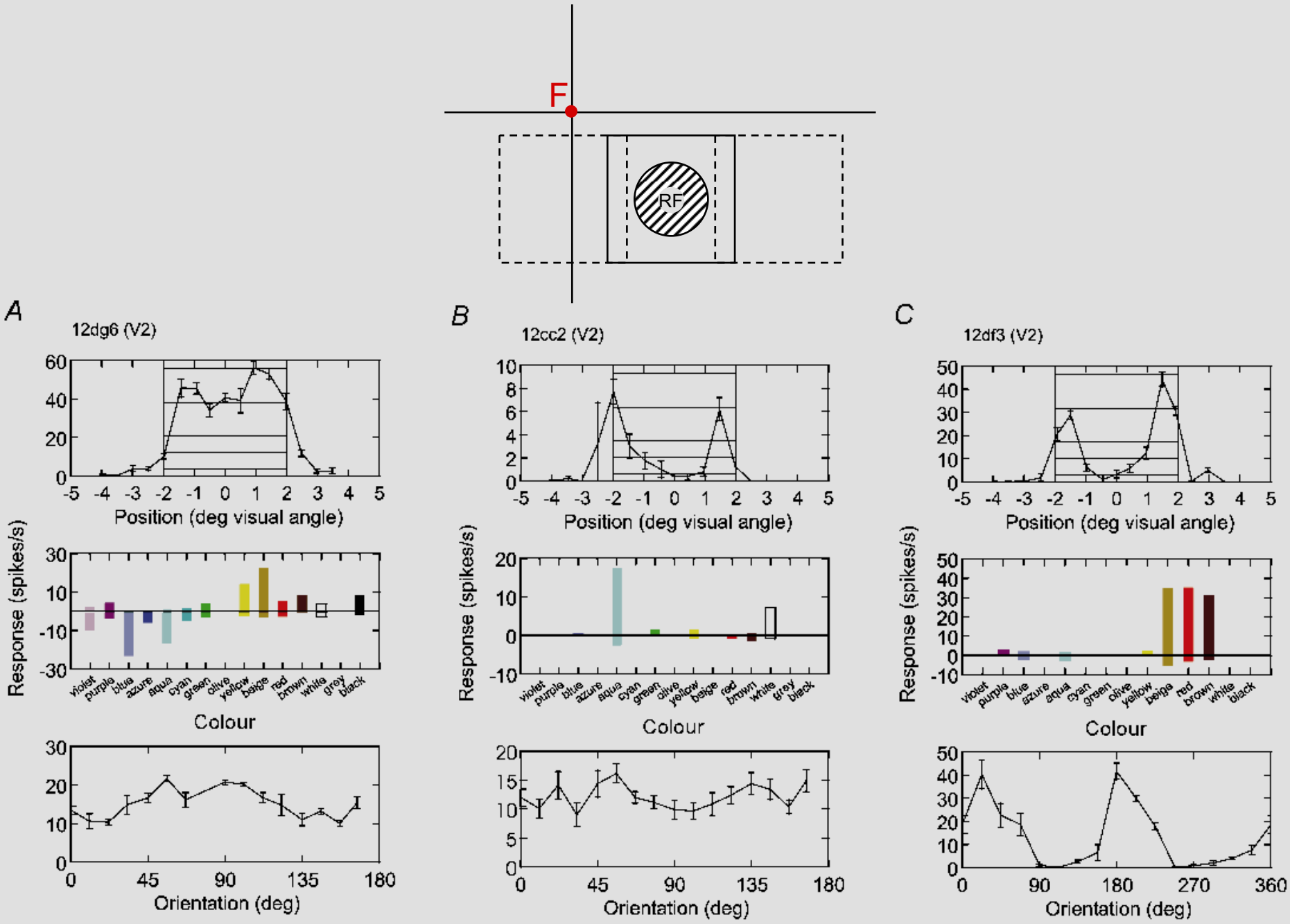


H. Zou et al, JoNS, ´00

SEGMENTATION 2: relation figure - contour



H. Zou et al, JoNS, ´00



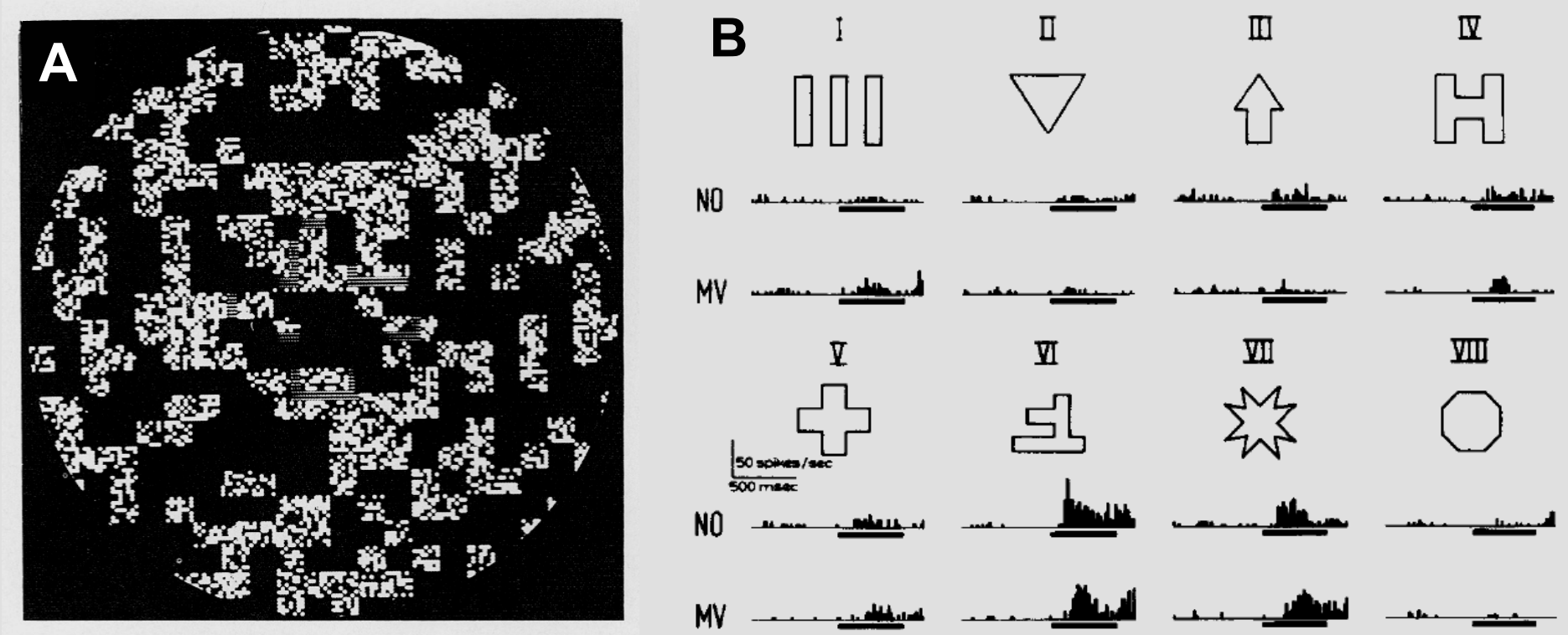
H.S. Friedman et al, J. of physiology, ´03

SEGMENTATION 3: compléter la figure

Le cortex extrastrié proche de V1 résous le problème 3:
Compléter l'image de l'objet de façon amodale ?
seulement restauration de la continuité des contours

SEGMENTATION 3: compléter la figure

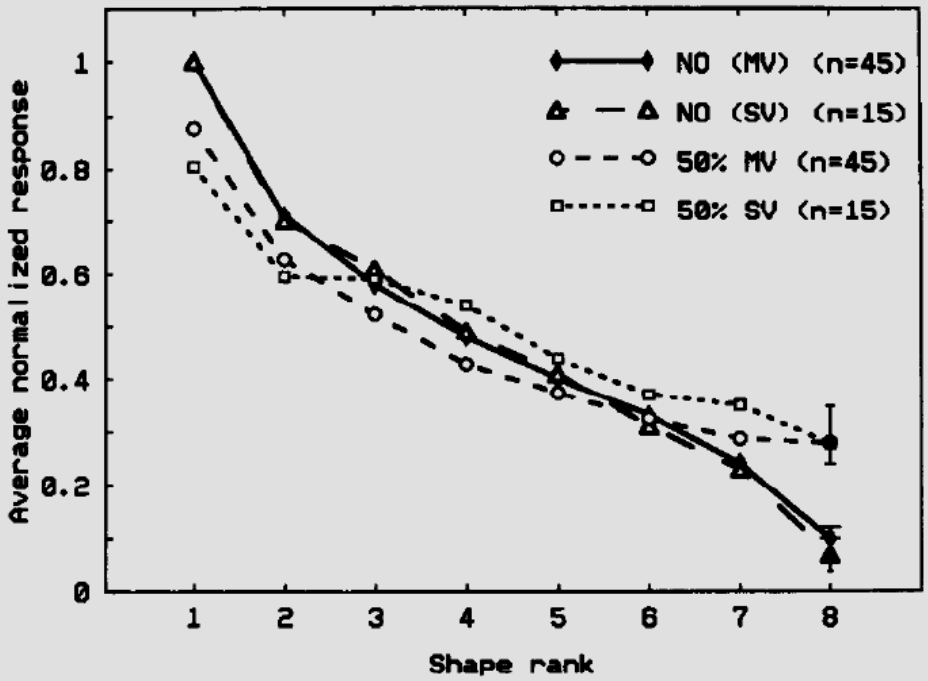
Neurone inféro-temporal

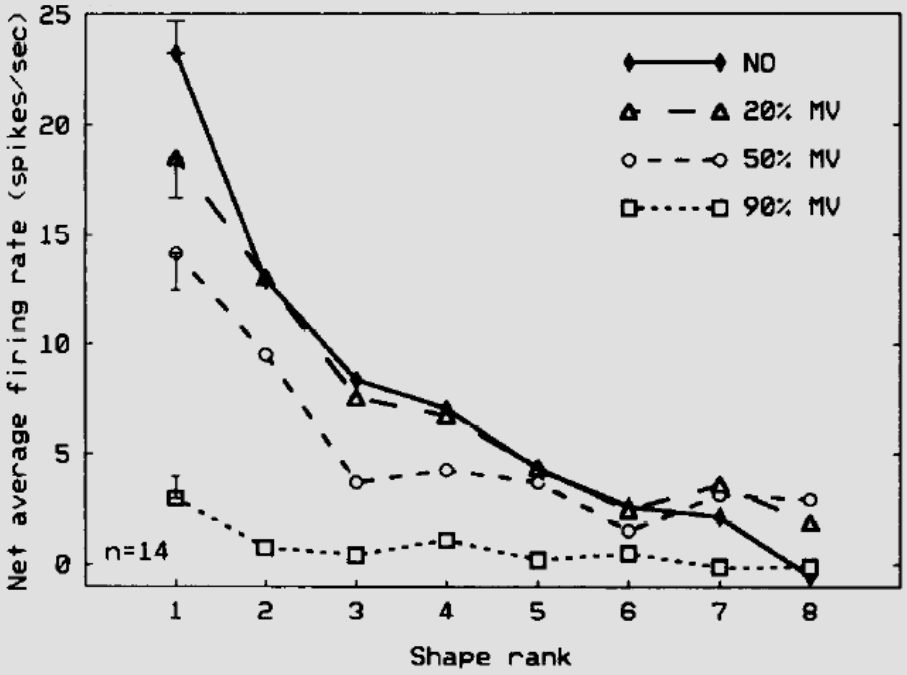


G. Kovács et al, JoNS, ´95

SEGMENTATION 3: compléter la figure

Population IT

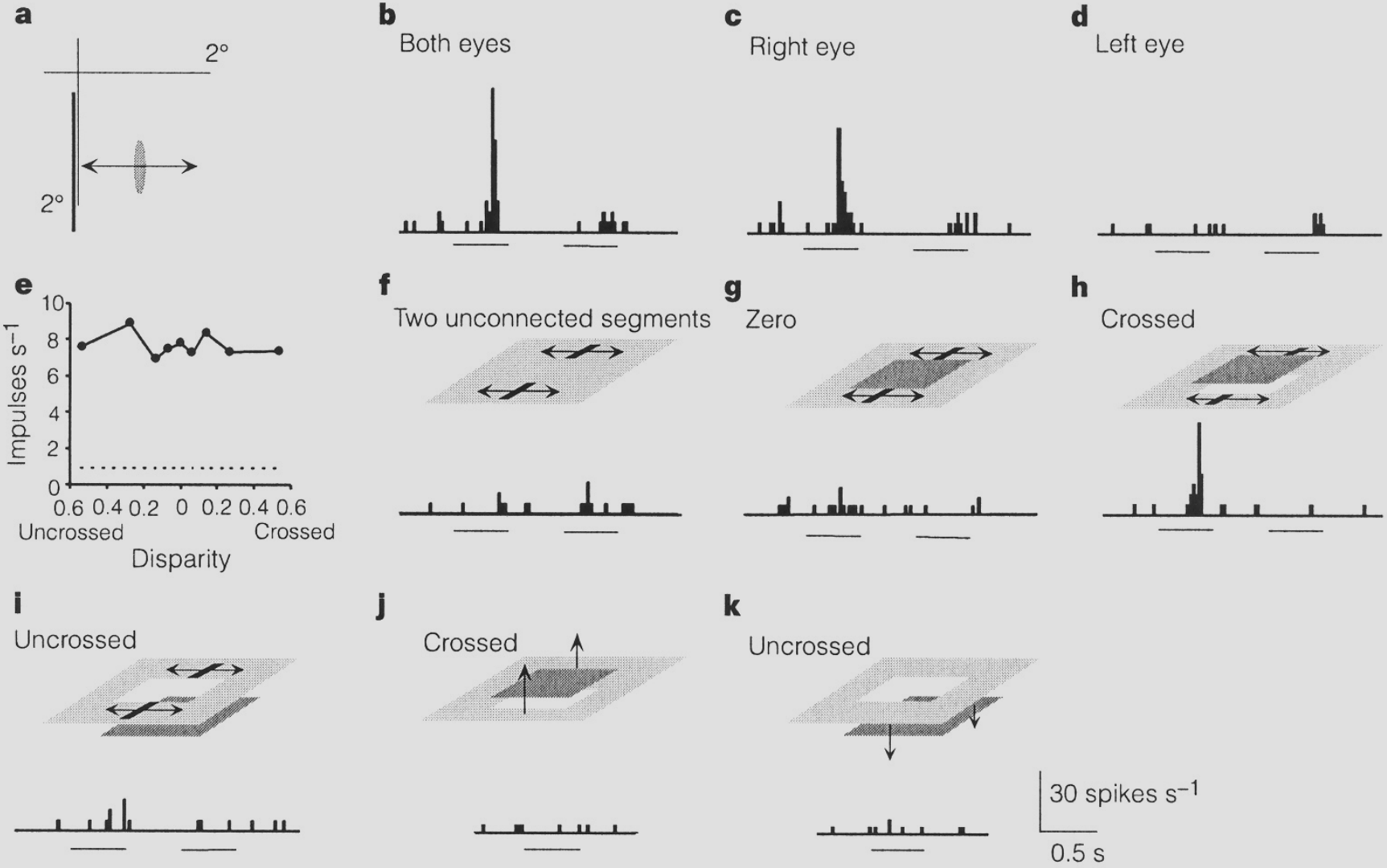




G. Kovács et al, JoNS, ´95

SEGMENTATION 3: compléter la figure

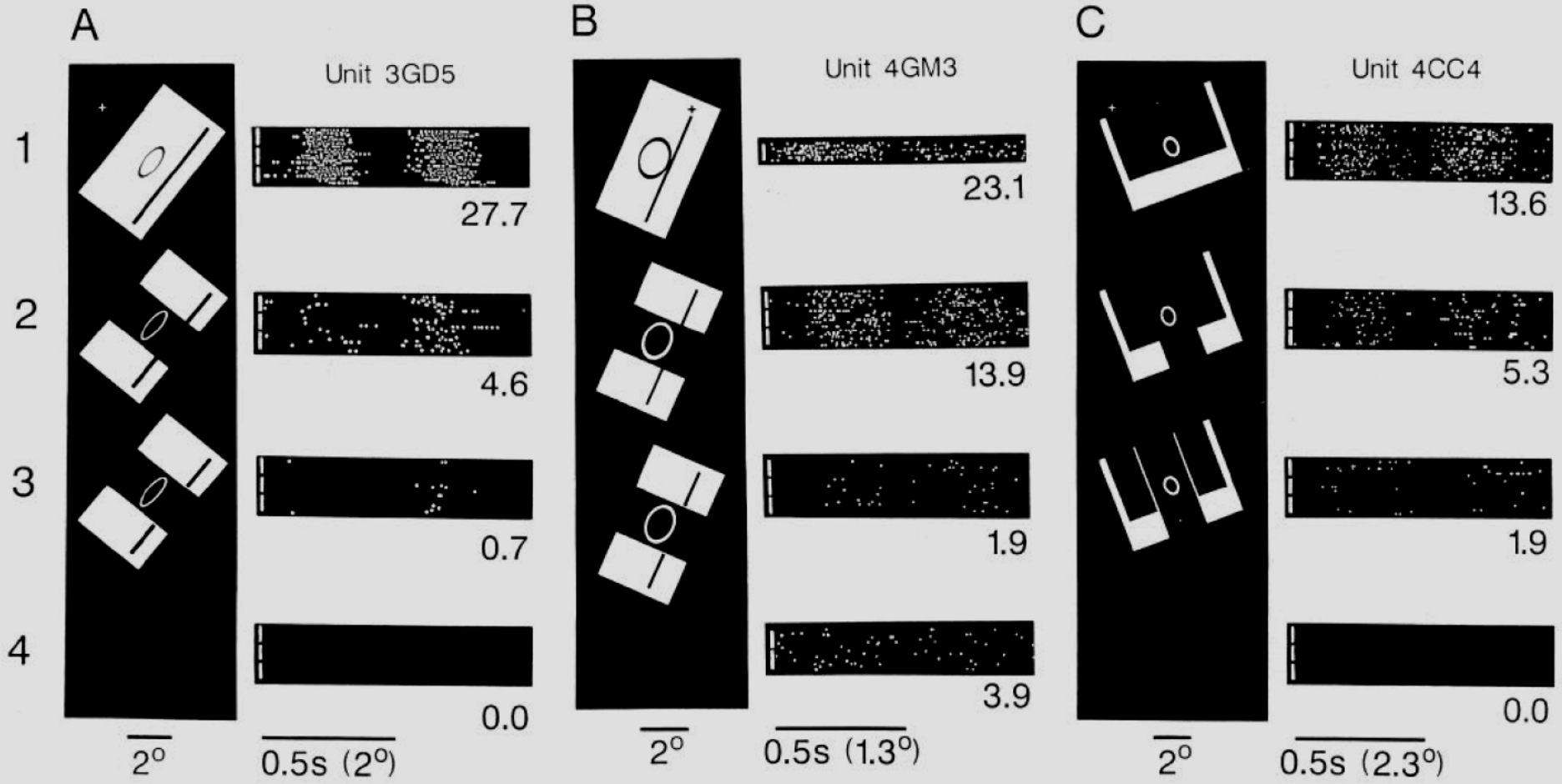
Neurone V1



Y. Sugita, Nature, ′99

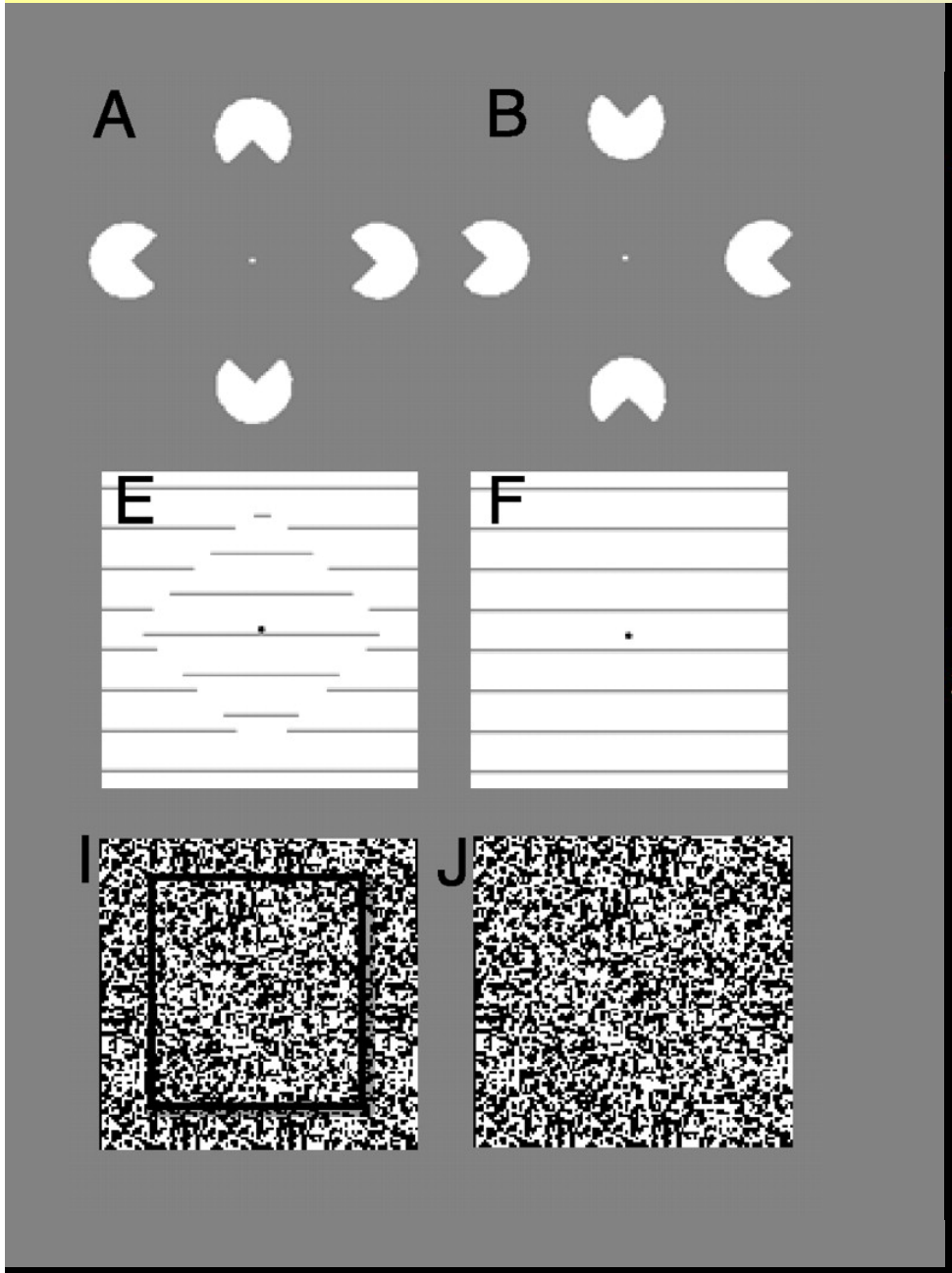
SEGMENTATION 3: compléter la figure

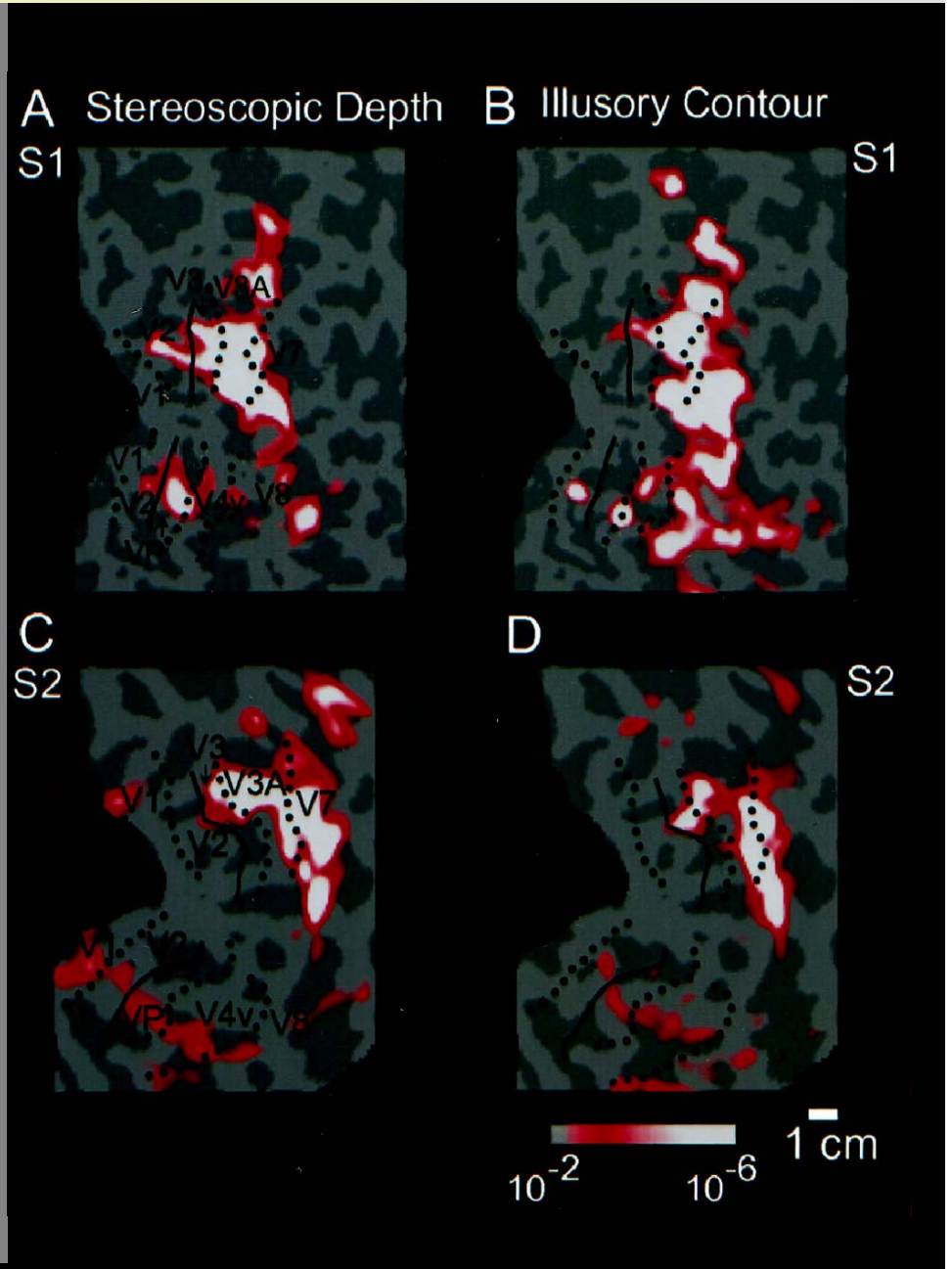
Compléter de façon modale



E. Peterhans and R. von der Heydt, JoNS, ´89

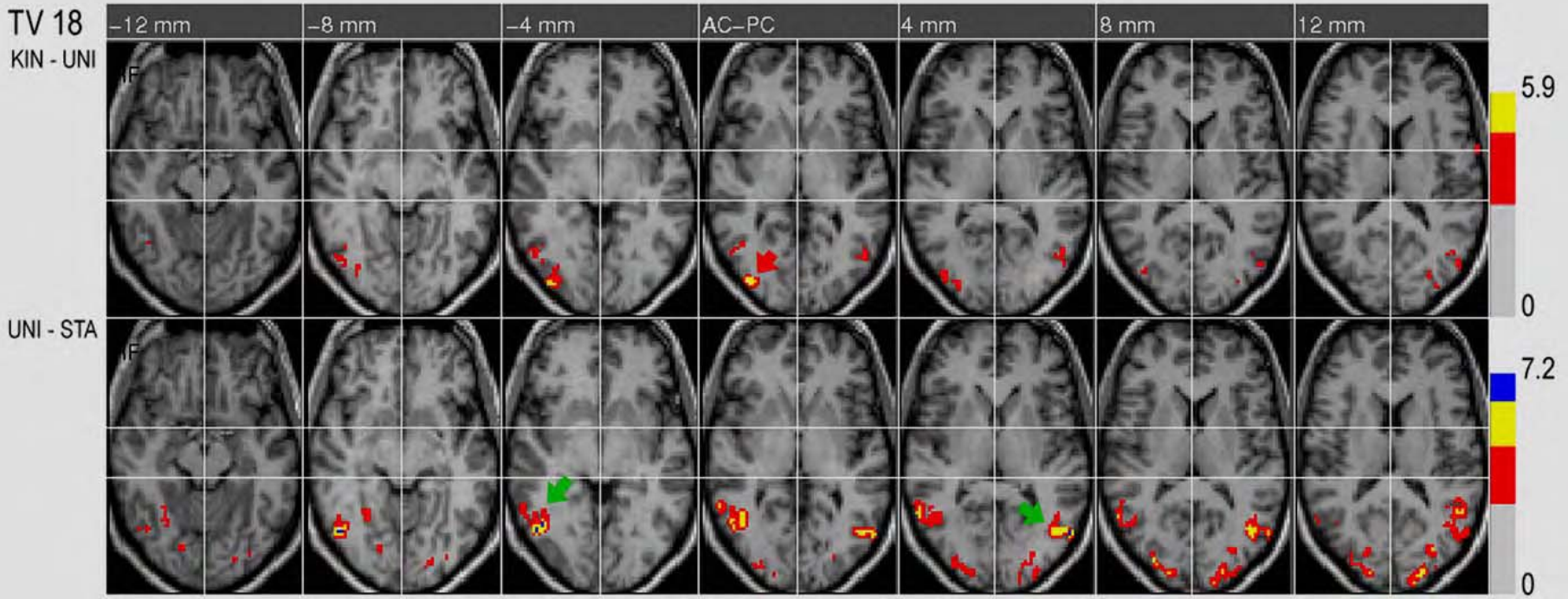
SEGMENTATION: imagerie fonctionnelle

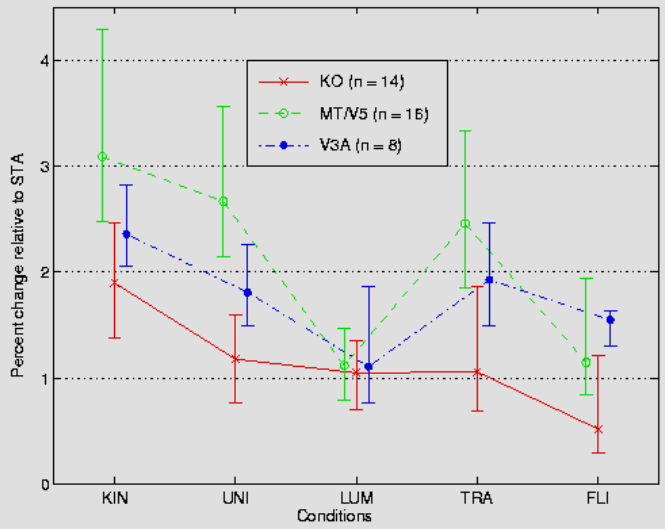


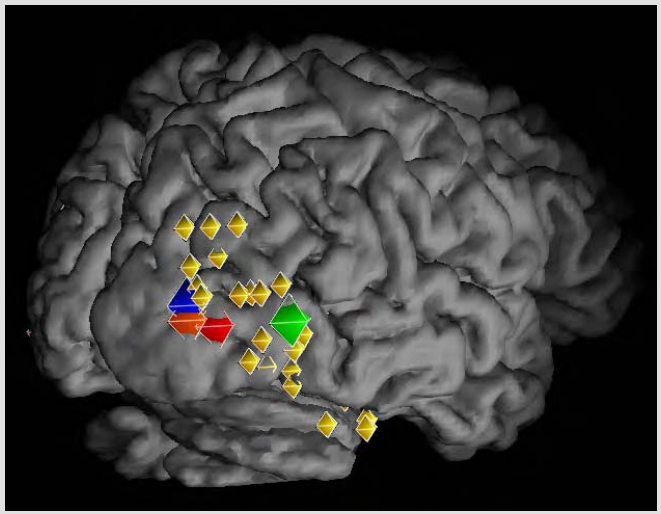


J.D. Mendola et al, JoNS, ´99

SEGMENTATION: imagerie fonctionnelle



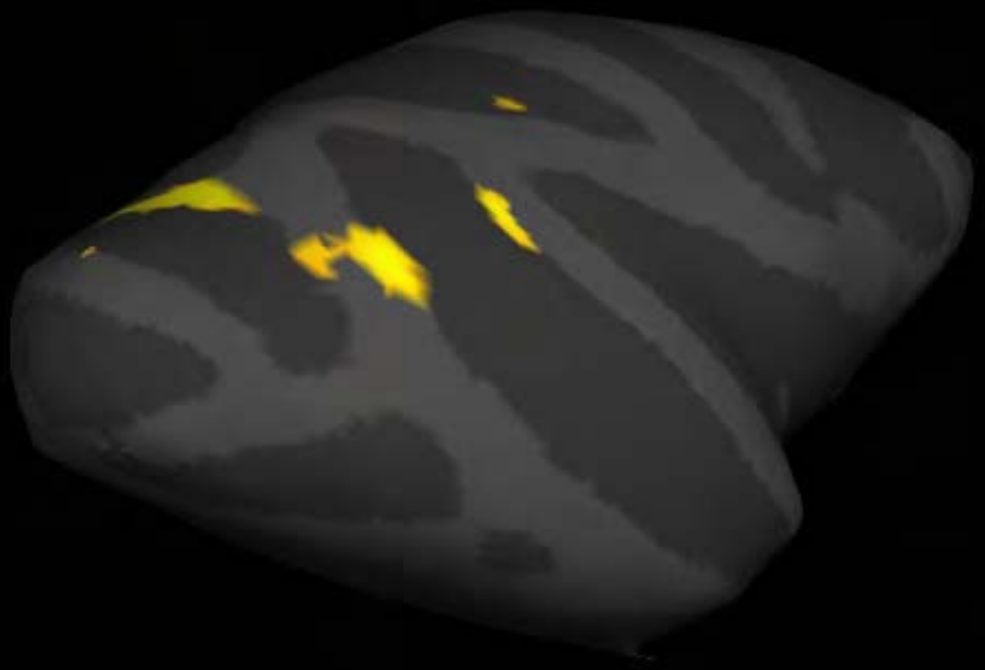




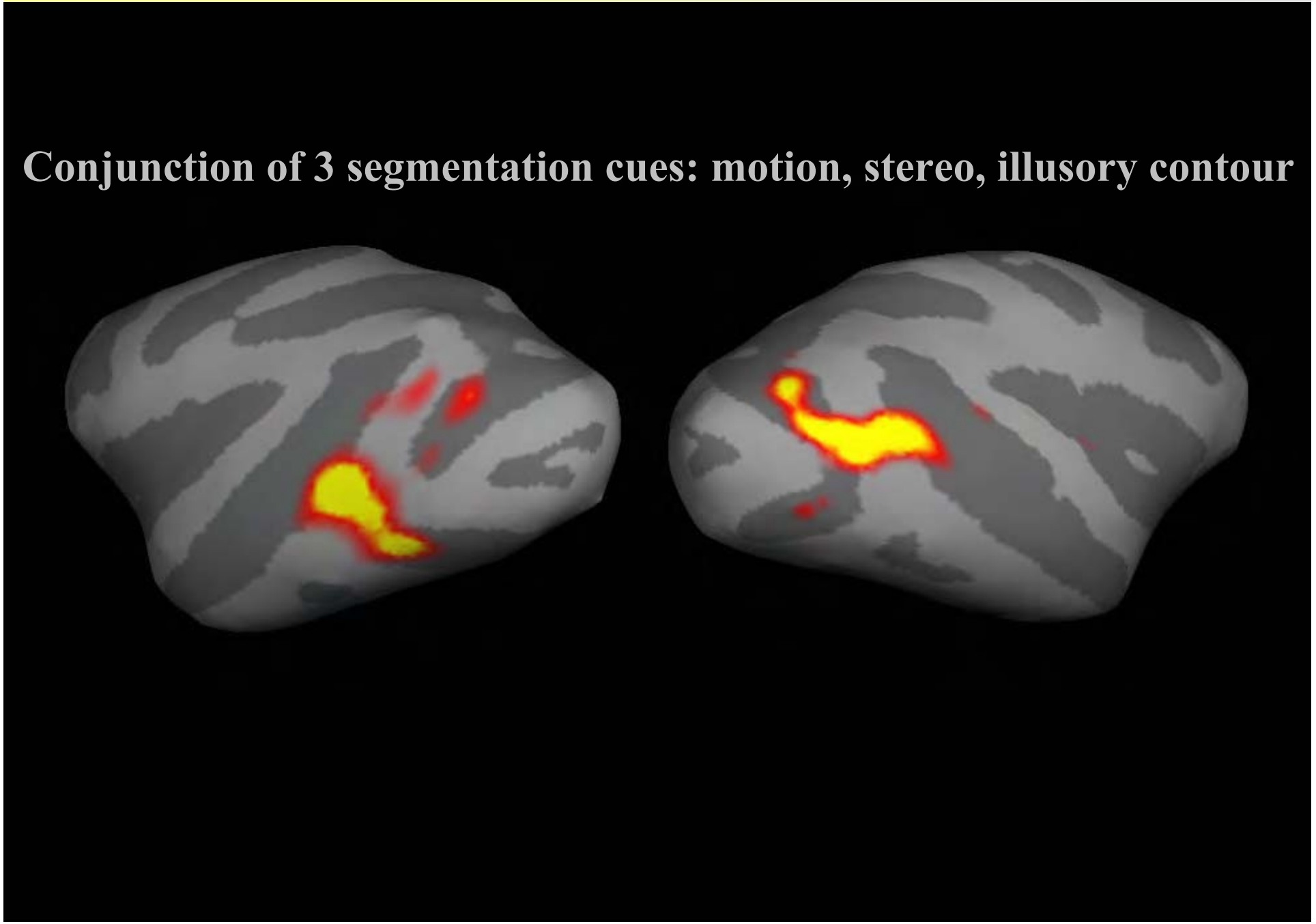
S. Van Oostende et al, Cerebral Cortex, ´97

Kinetic - transparent motion (MION, M3)
monkey fMRI

(grating, 14 deg diameter)



SEGMENTATION: imagerie fonctionnelle



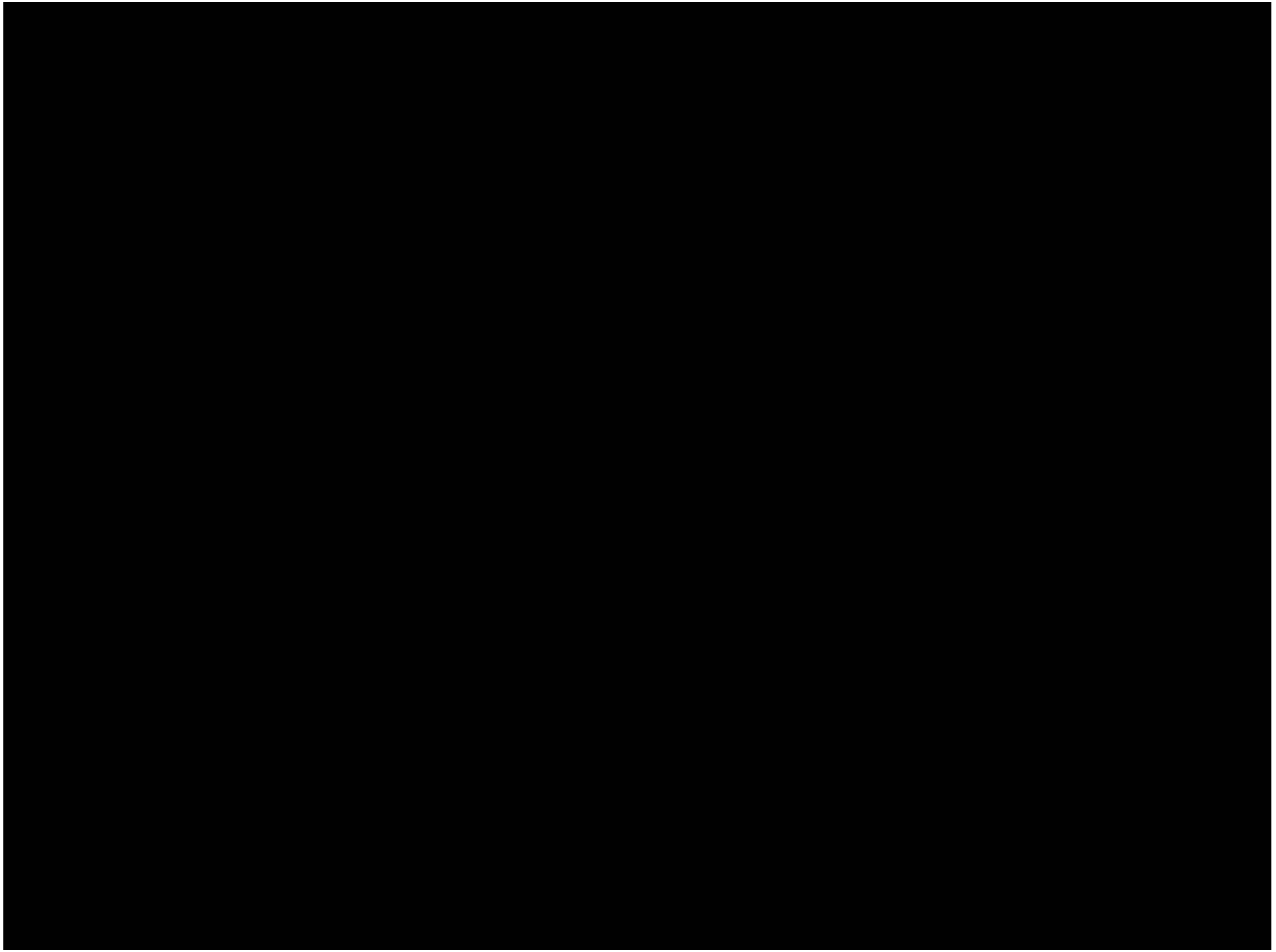
CONCLUSION

Conclusions

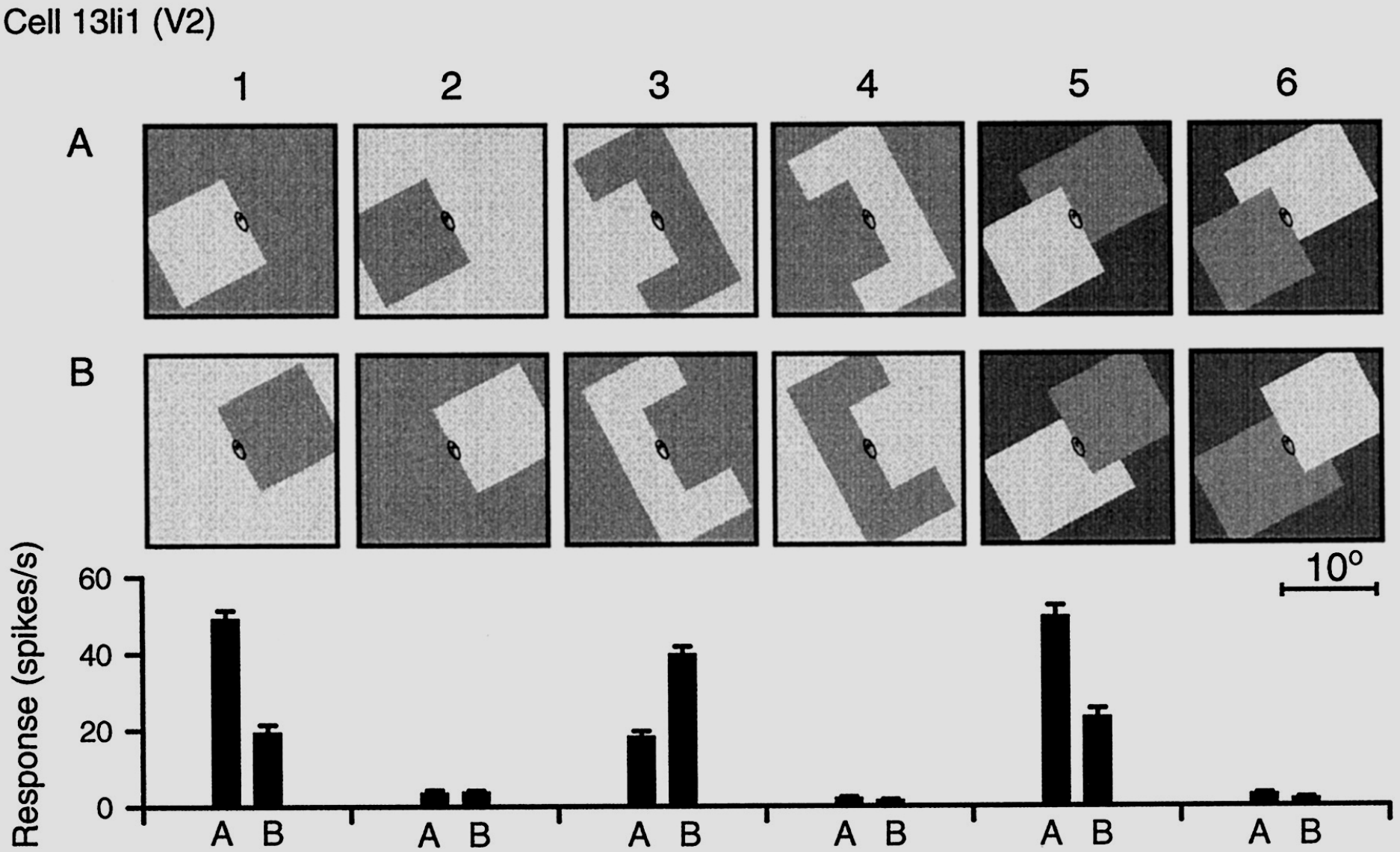
1 mechanismes de la segregation de l'image d'un objet du fond (V2-V4):
- **extraction de contours definis par attributs autre que luminance qui convergent avec contours lumineux**
- **localisation localement de la figure (image de l'objet) par rapport au contour**
- **analyse locales des surfaces**

2 resolution des occlusions: largement inconnue (prolongation de contours est possible), mais la solution existe (visible au niveau de IT)

3 l'imagerie fonctionnelle indique traitement des contours non lumineux dans aires moyennes (au dela de V3) chez l'homme, mais l'interpretation est ambigue, solution possible par imagerie chez le singe vigile.



SEGMENTATION 3: compléter la figure



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