L'étroite complémentarité entre la vision et le toucher: Études psychophysiques et cérébrales chez la personne voyante et non-voyante

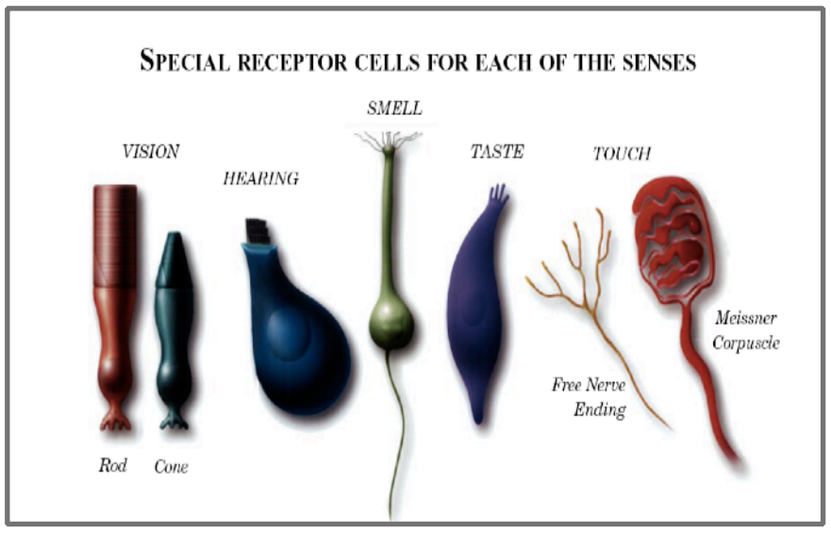
[Olivier Collignon]

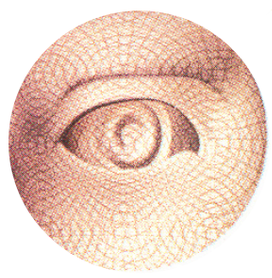
CPP-Lab
CROSSMODAL PERCEPTION PLASTICITY

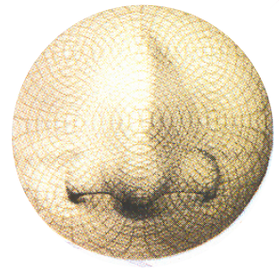
UCLouvain

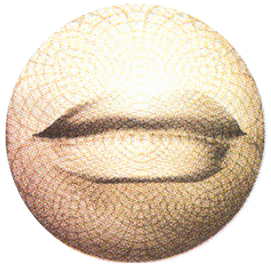
the sense

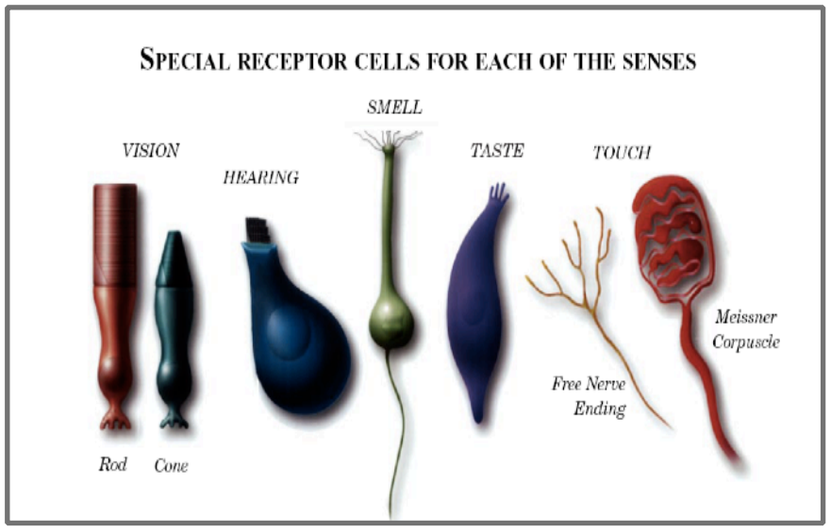
Hes·so VALAIS WALLIS

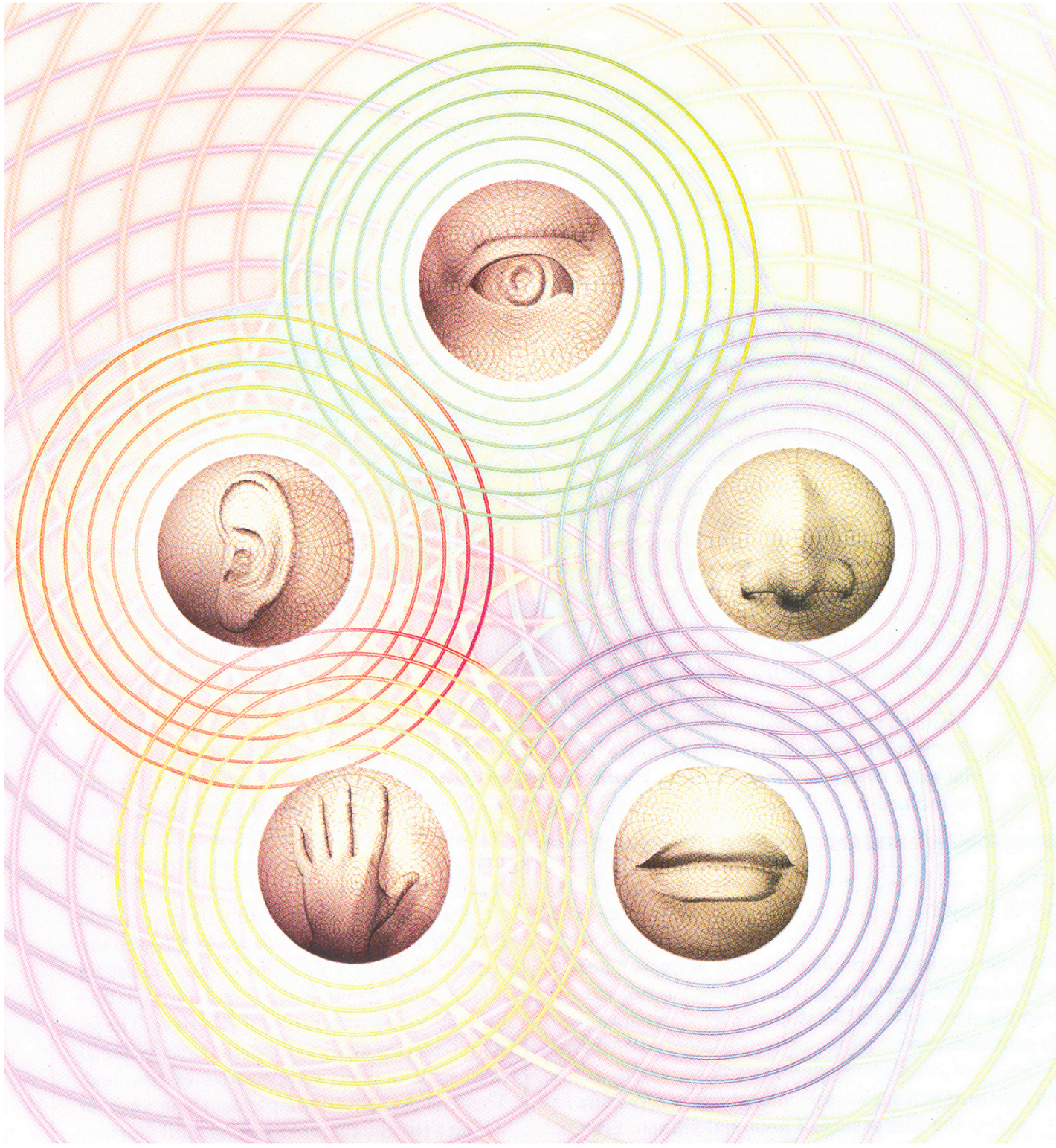

SPECIAL RECEPTOR CELLS FOR EACH OF THE SENSES
VISION
HEARING
SMELL
TASTE
TOUCH
Rod
Cone
Free Nerve Ending
Meissner Corpuscle

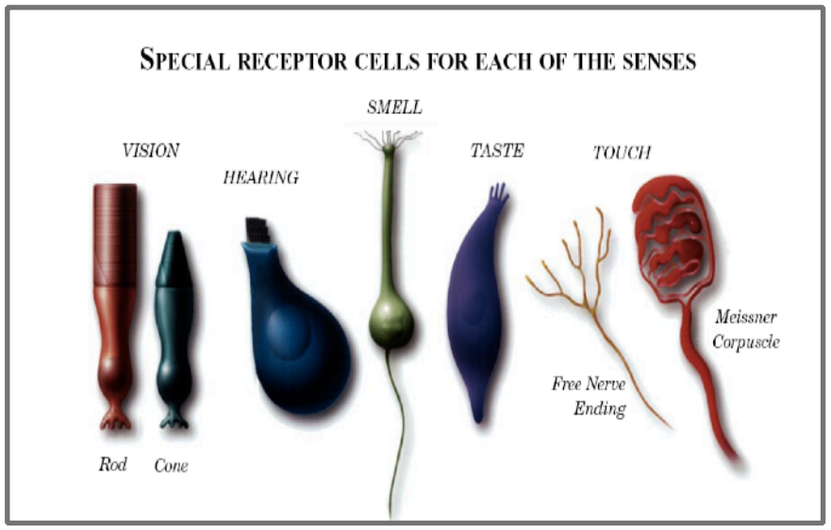


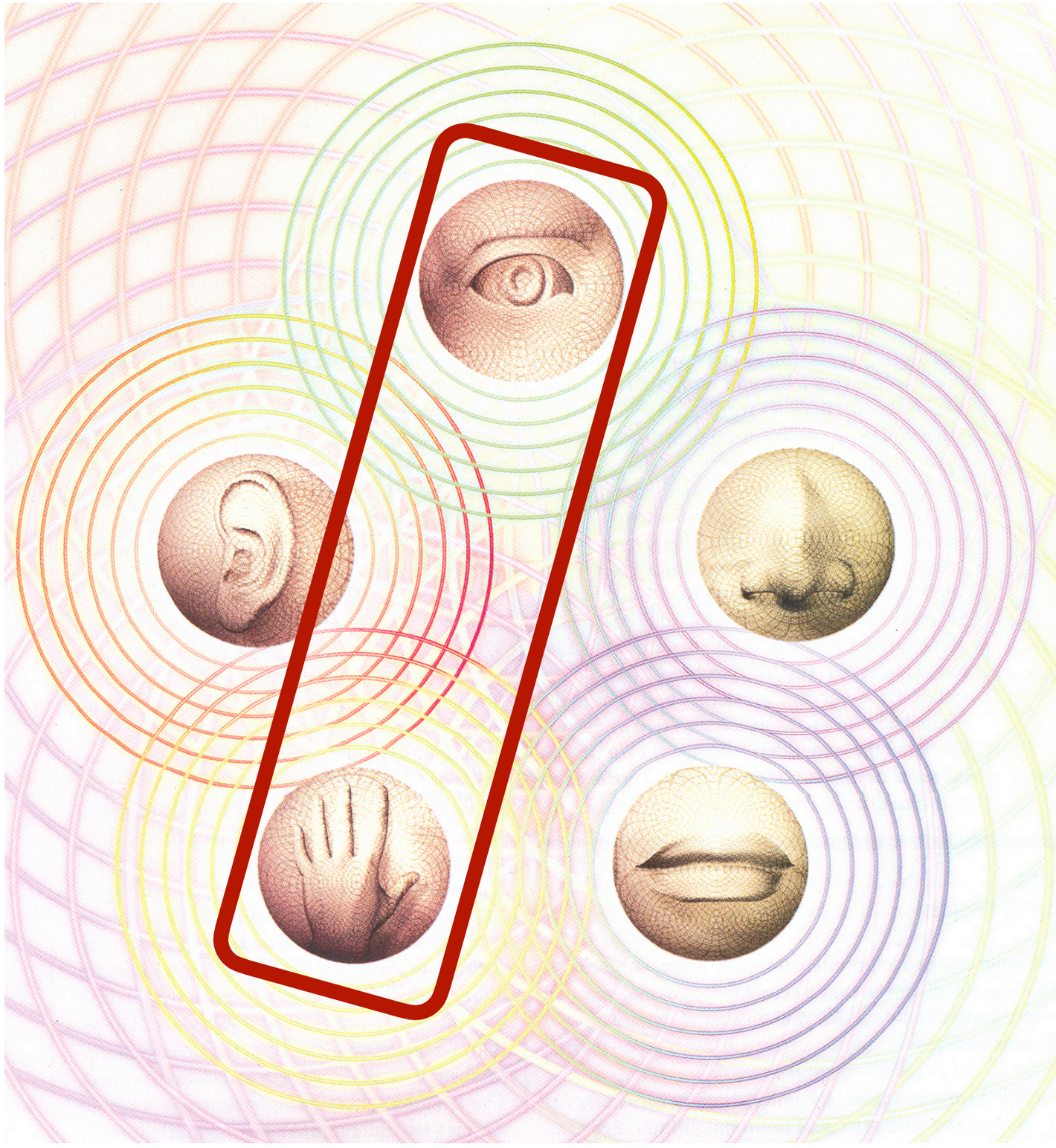





SPECIAL RECEPTOR CELLS FOR EACH OF THE SENSES
VISION
HEARING
SMELL
TASTE
TOUCH
Rod
Cone
Free Nerve Ending
Meissner Corpuscle



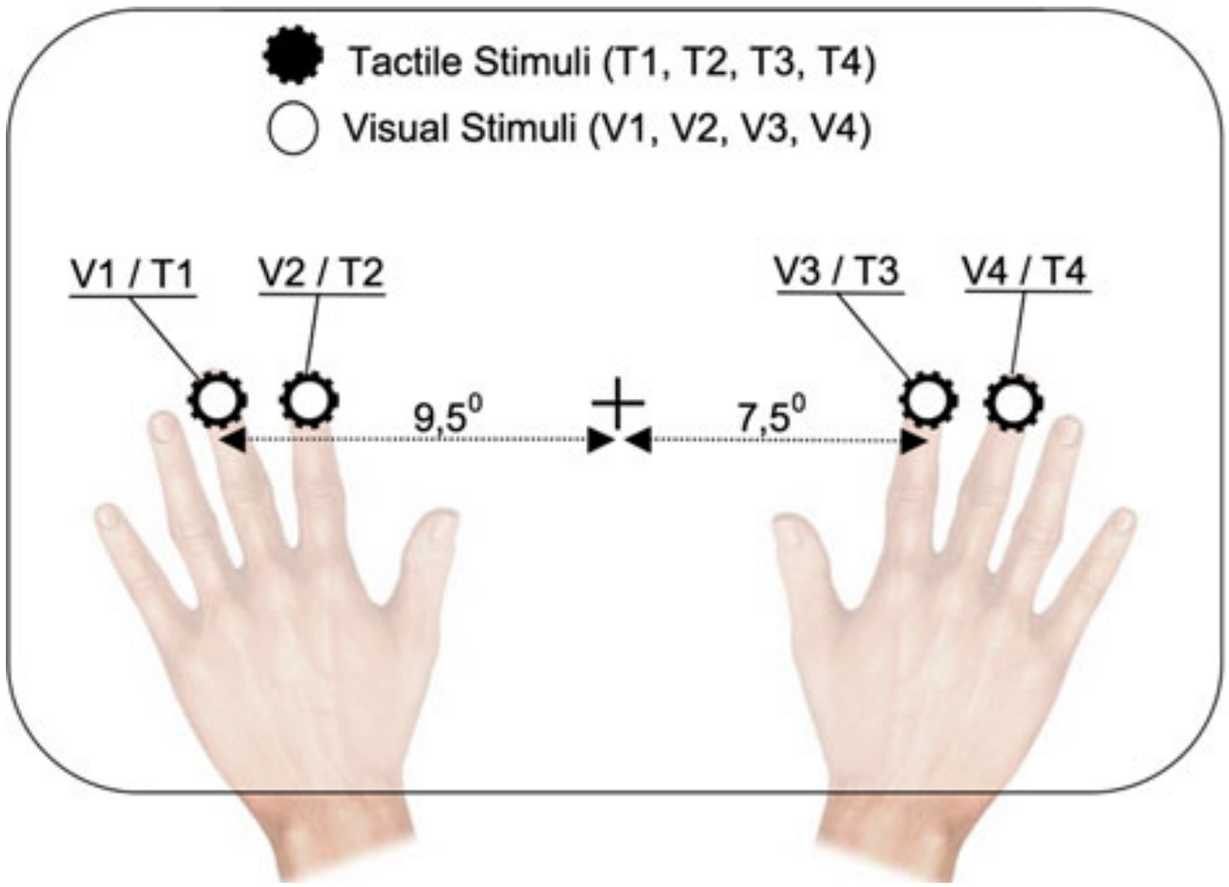

SPECIAL RECEPTOR CELLS FOR EACH OF THE SENSES
VISION
HEARING
SMELL
TASTE
TOUCH
Rod
Cone
Free Nerve Ending
Meissner Corpuscle



"Low-level"

Visuo-Tactile integration

Simple detection task: Uni- vs Multi-sensory Integration



Stimulation Conditions

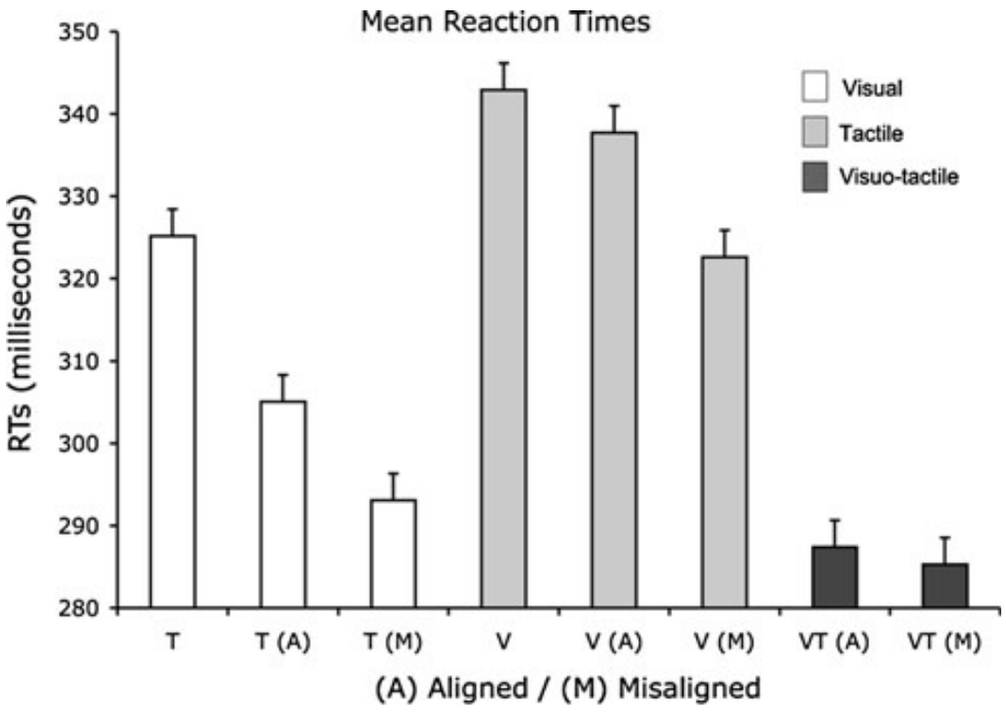
- **Unimodal**
  - Single Visual = V1, V2, V3, V4
  - Single Tactile = T1, T2, T3, T4
- **Within-modal**
  - Double Visual (Aligned) = V1/V2, V3/V4
  - Double Visual (Misaligned) = V1/V3, V2/V4
  - Double Tactile (Aligned) = T1/T2, T3/T4
  - Double Tactile (Misaligned) = T1/T3,T2/T4
- **Cross-modal**
  - Visuo-Tactile (Aligned) = V1/T2, V2/T1, V3/T4, V4T3
  - Visuo-Tactile (Misaligned) = V1/T3, V2/T4, V3/T1, V4/T2

Girard et al. EBR 13

Simple detection task: Uni- vs Multi-sensory Integration

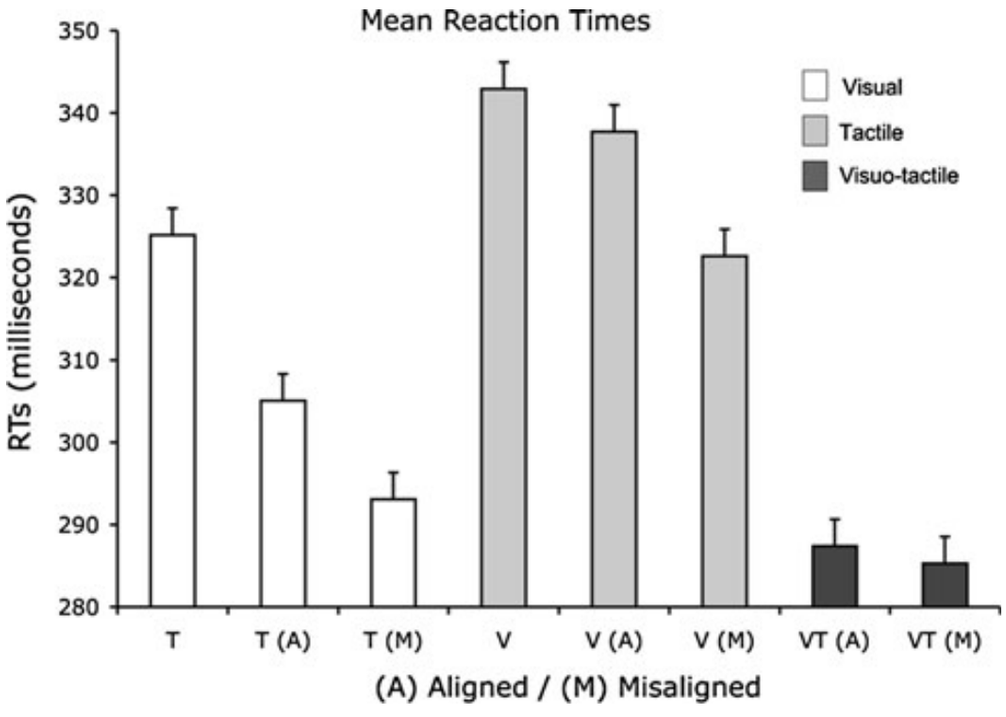
Girard et al. EBR 13

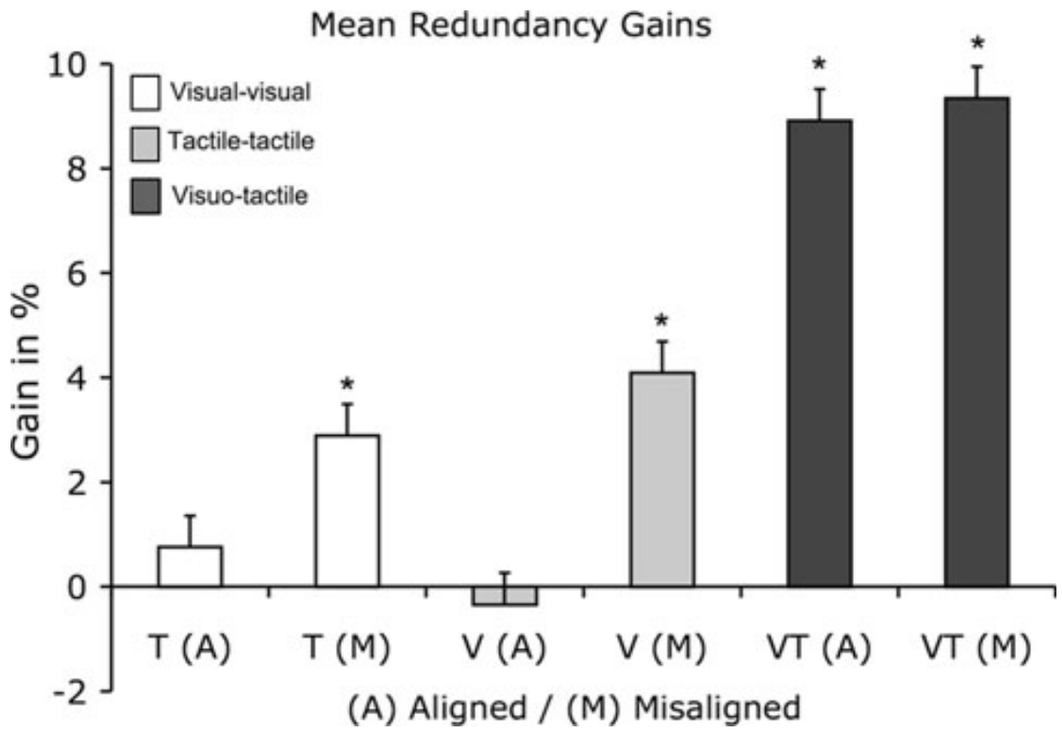
Simple detection task: Uni- vs Multi-sensory Integration



Girard et al. EBR 13

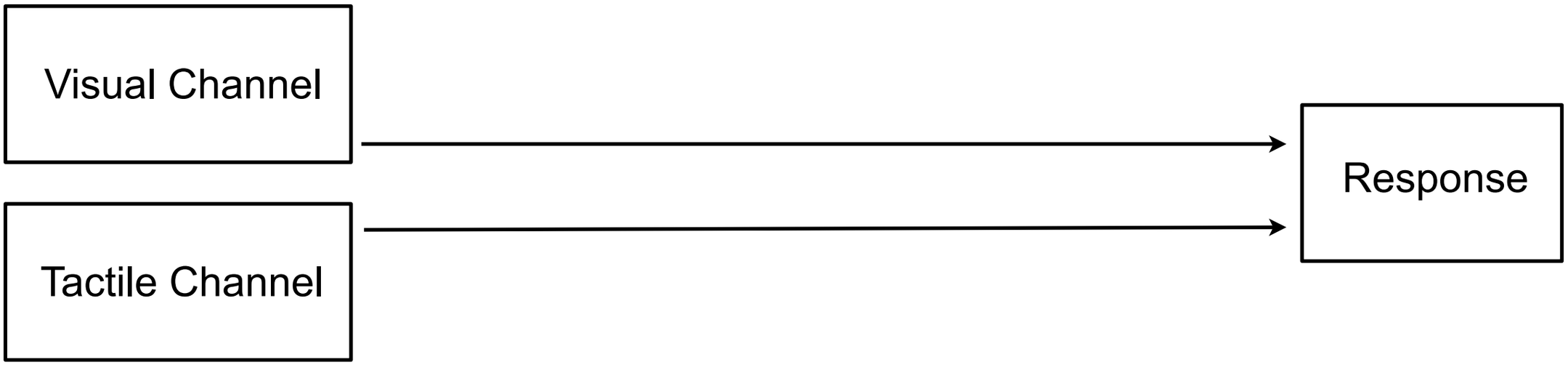
Simple detection task: Uni- vs Multi-sensory Integration



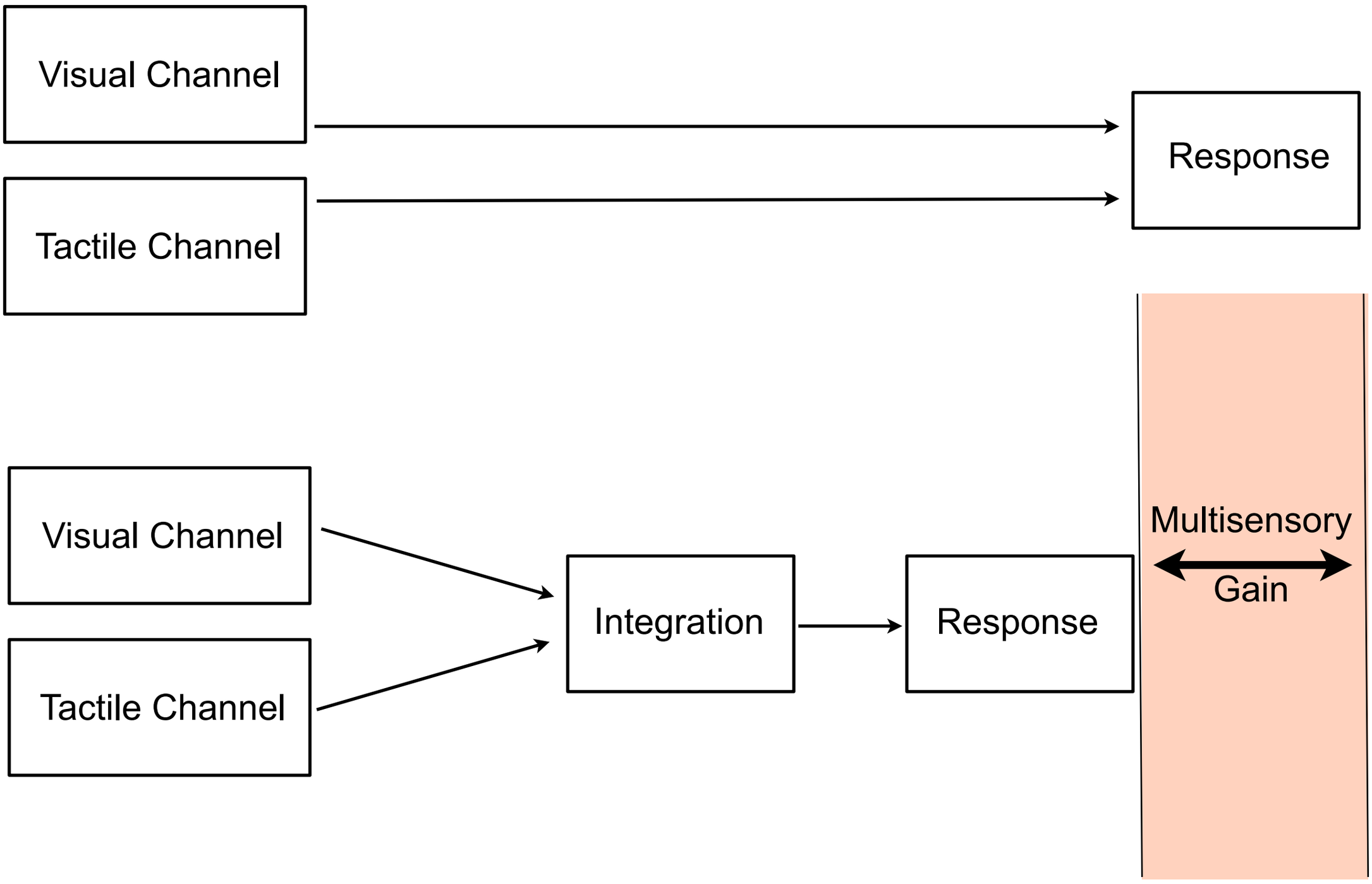


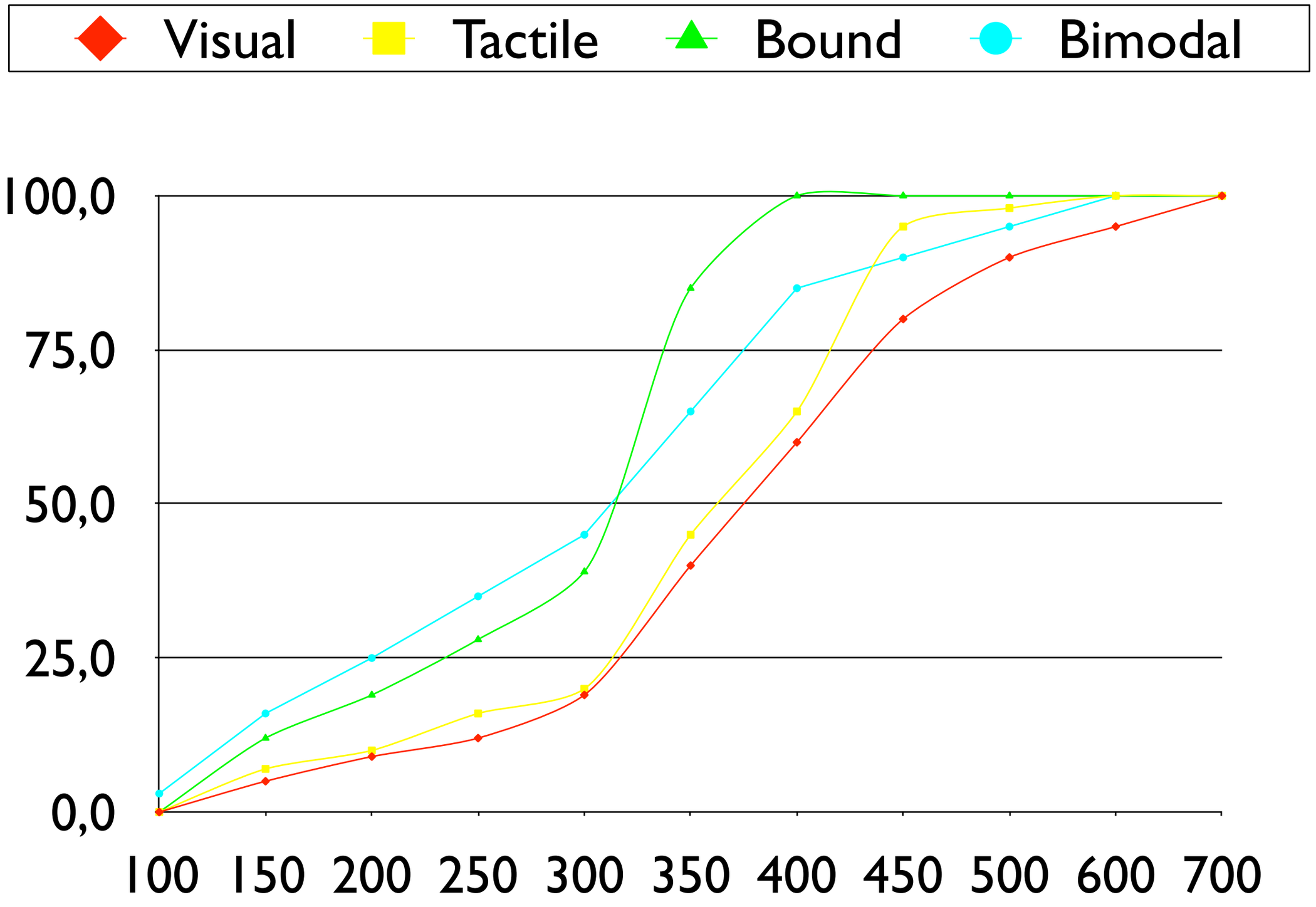
Girard et al. EBR 13

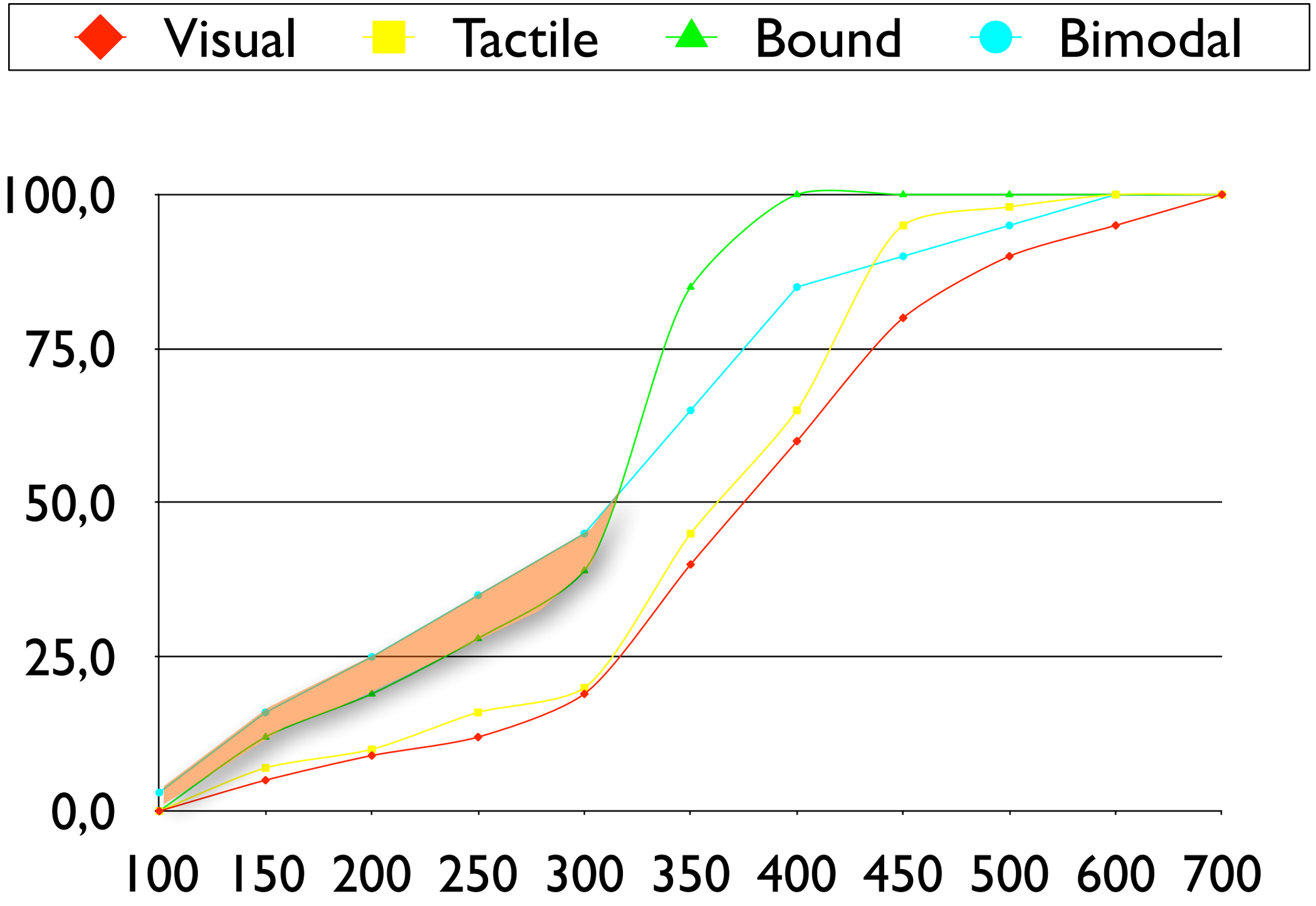
Redundancy Gain

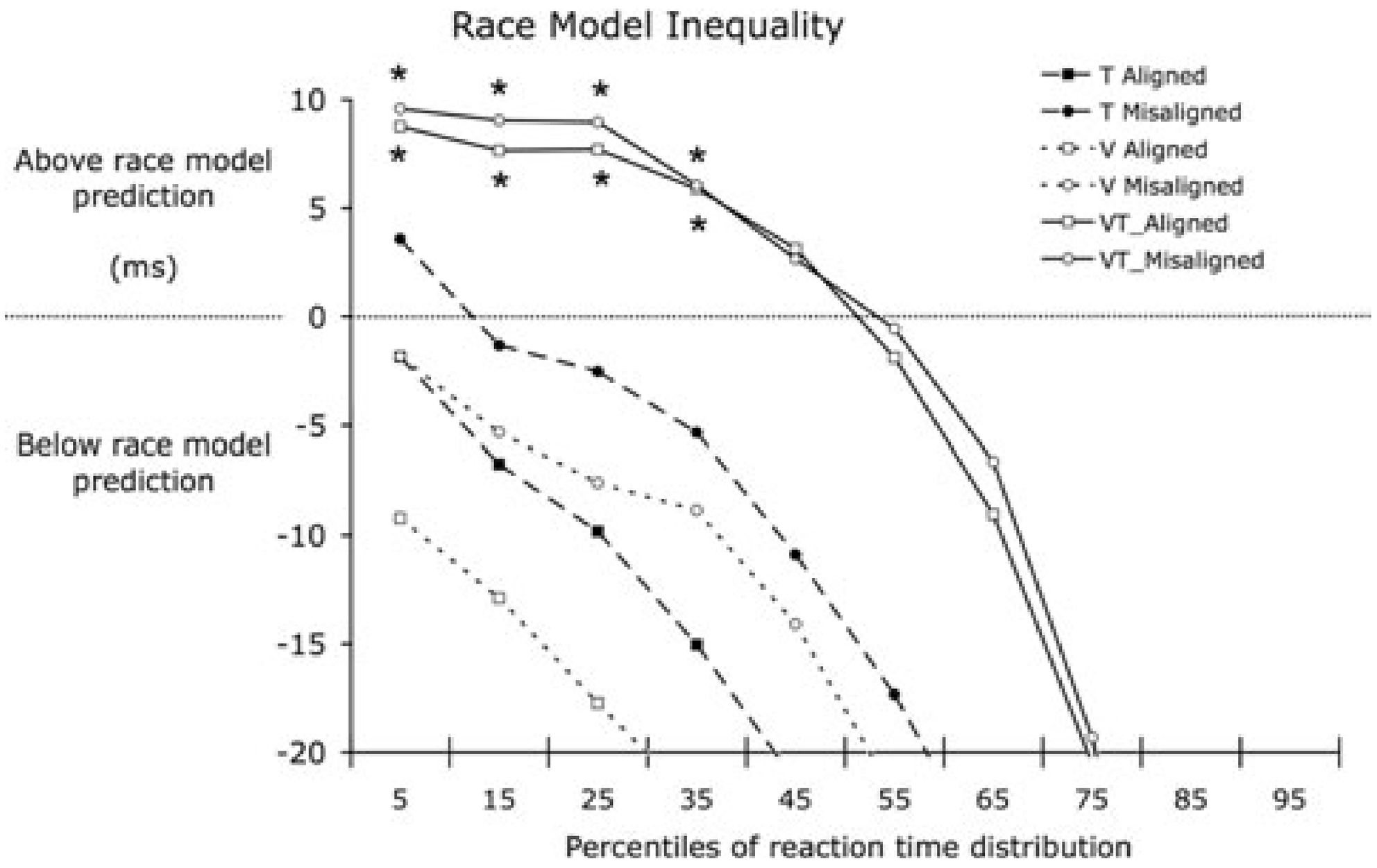


Redundancy Gain




Visual
Tactile
Bound
Bimodal
100,0
75,0
50,0
25,0
0,0
100
150
200
250
300
350
400
450
500
600
700


Visual
Tactile
Bound
Bimodal
100,0
75,0
50,0
25,0
0,0
100
150
200
250
300
350
400
450
500
600
700

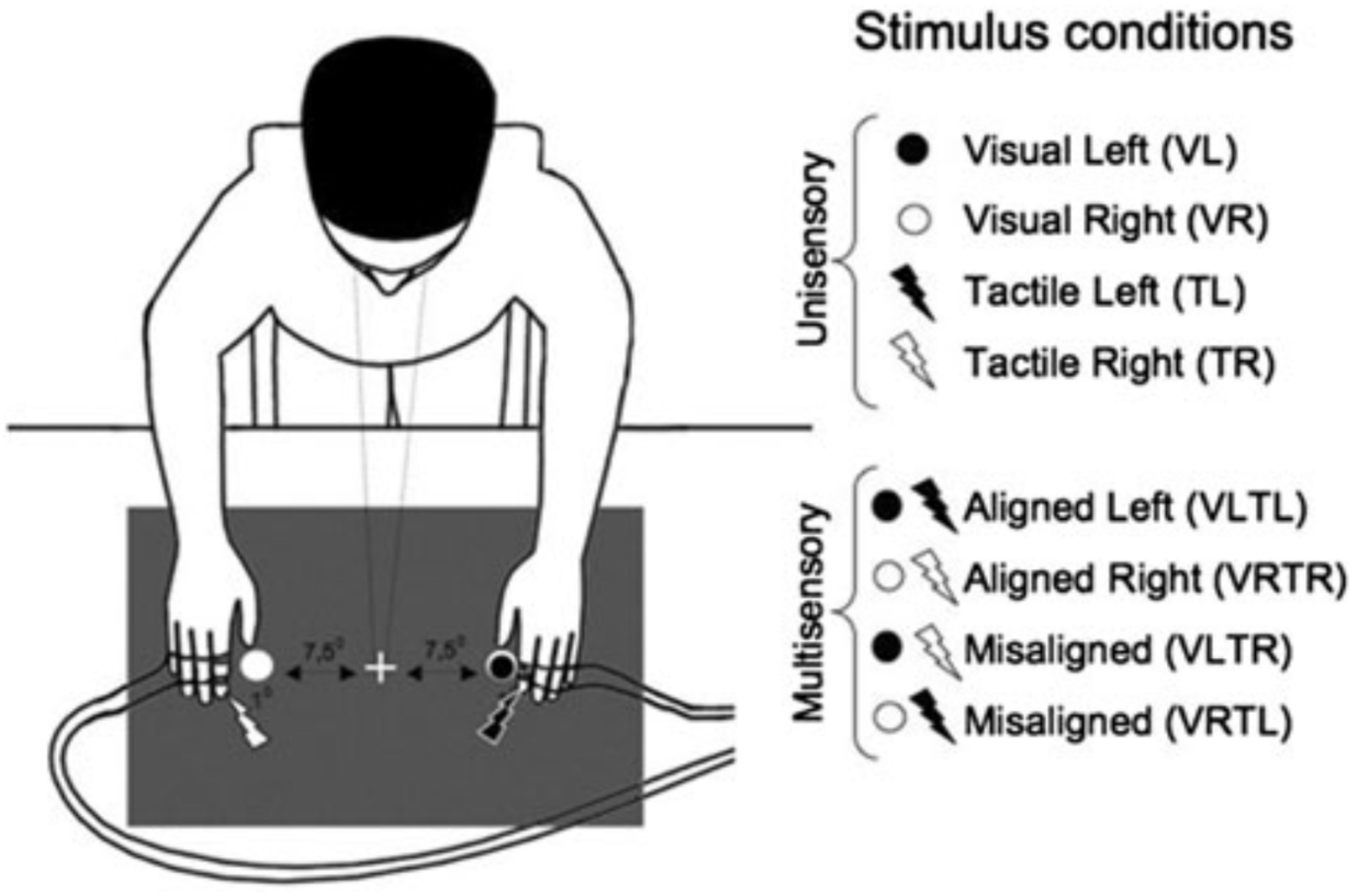


Girard et al. EBR 13

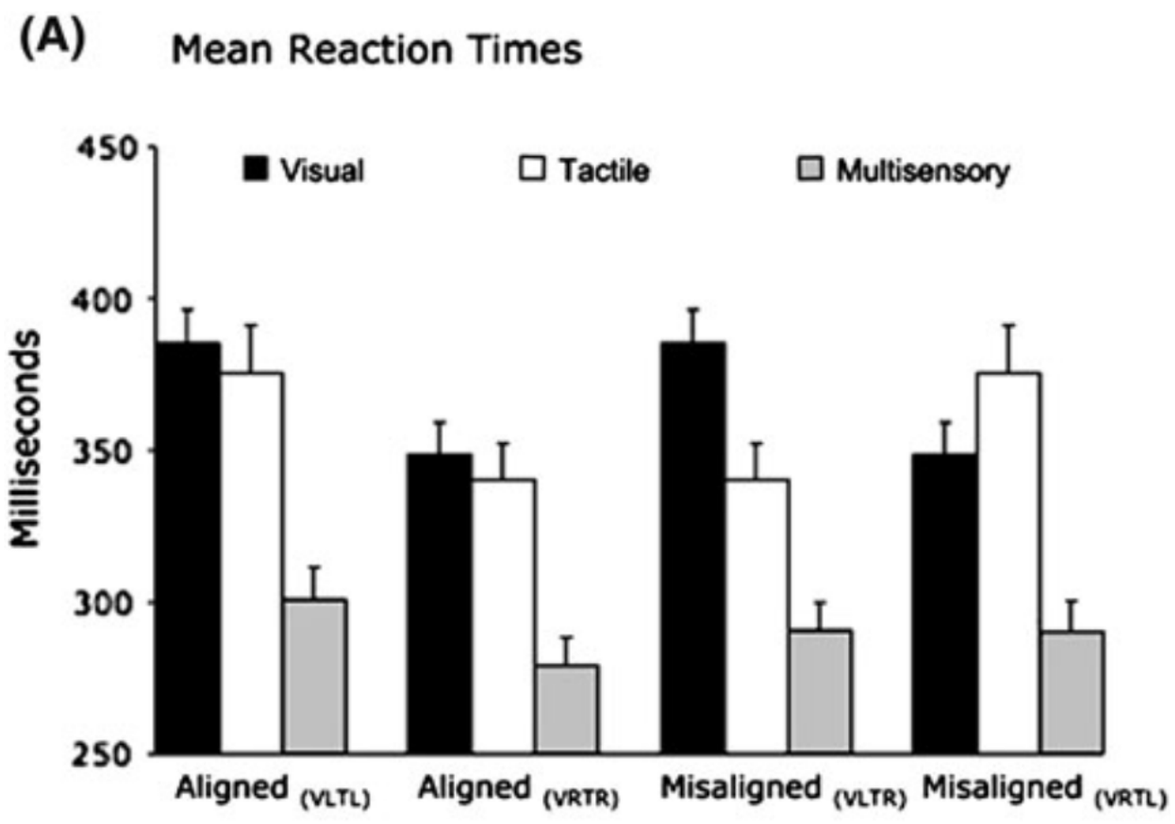
Does multisensory spatial congruence plays a role?

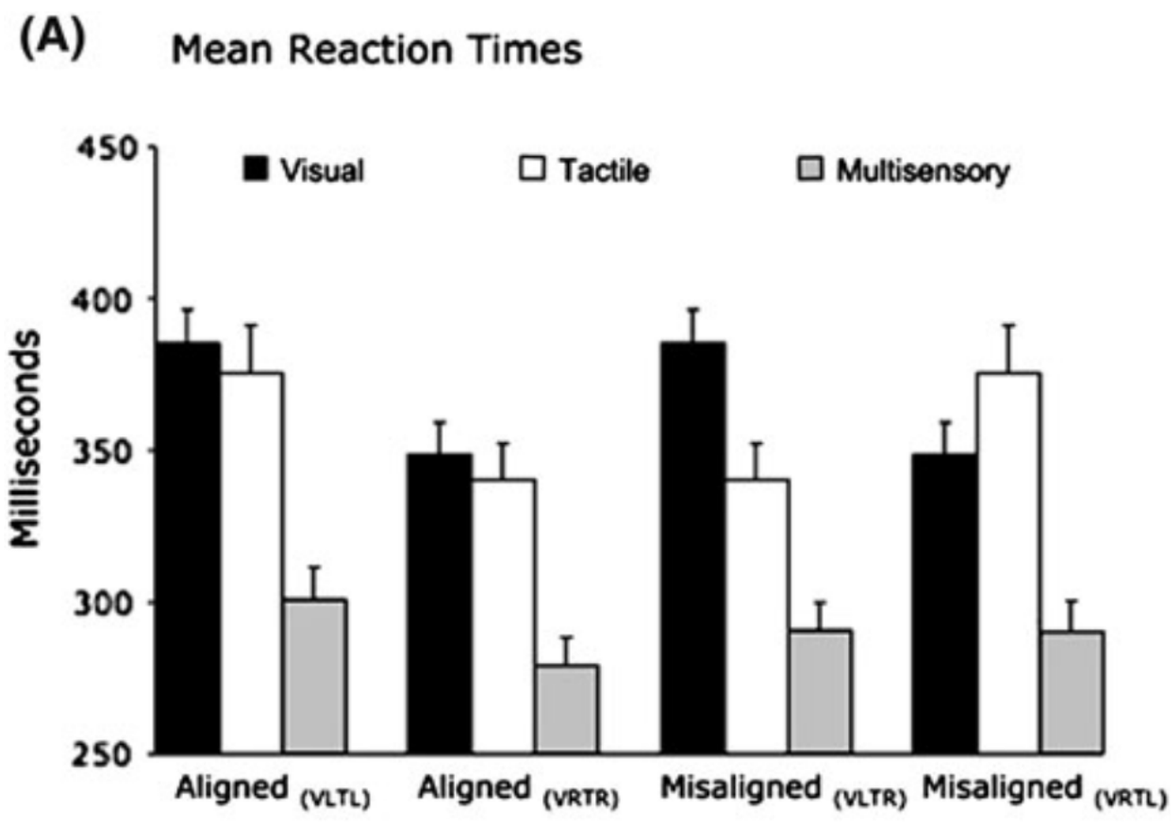
Condition 1: respond to all stimuli

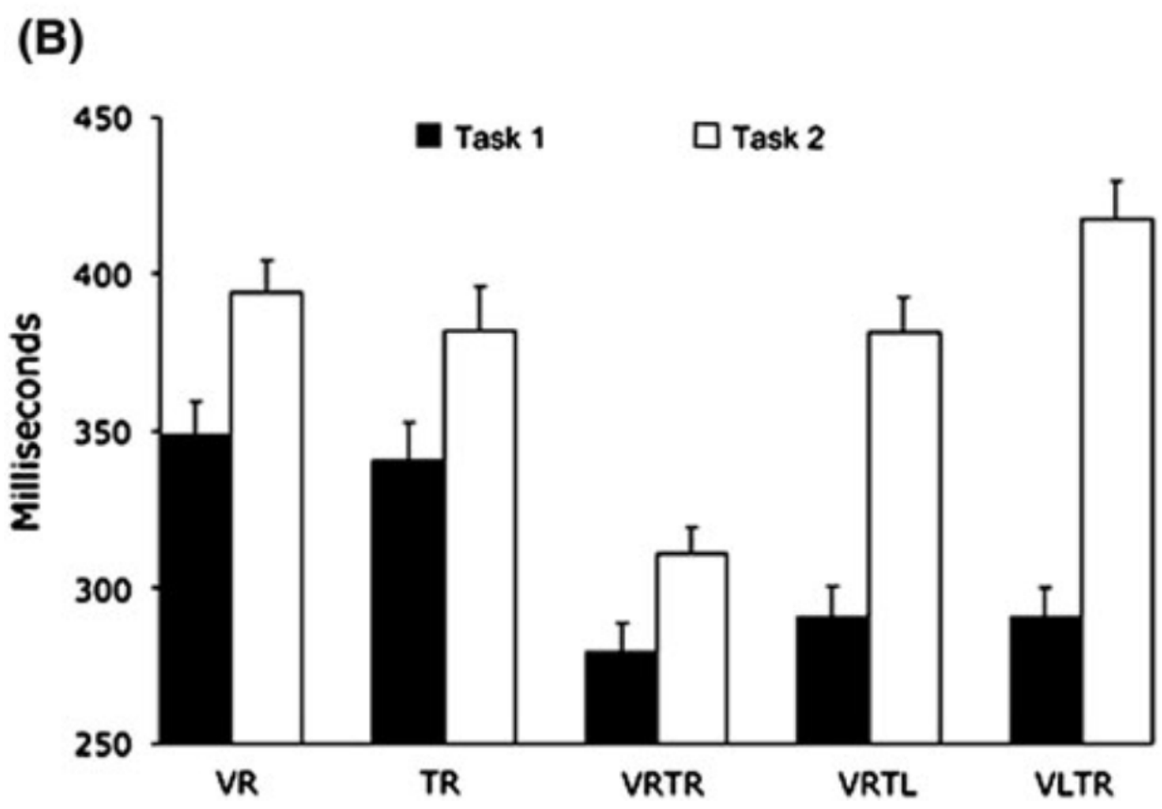
Condition 2: respond to right stimuli only



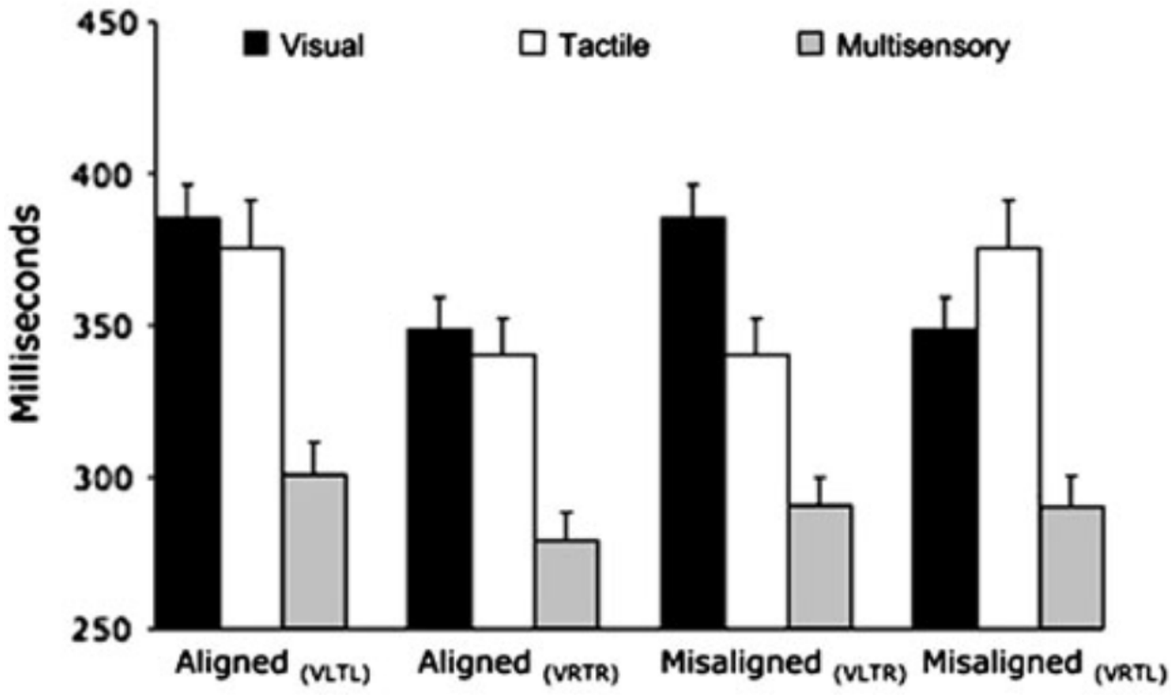
Girard et al. EBR 10

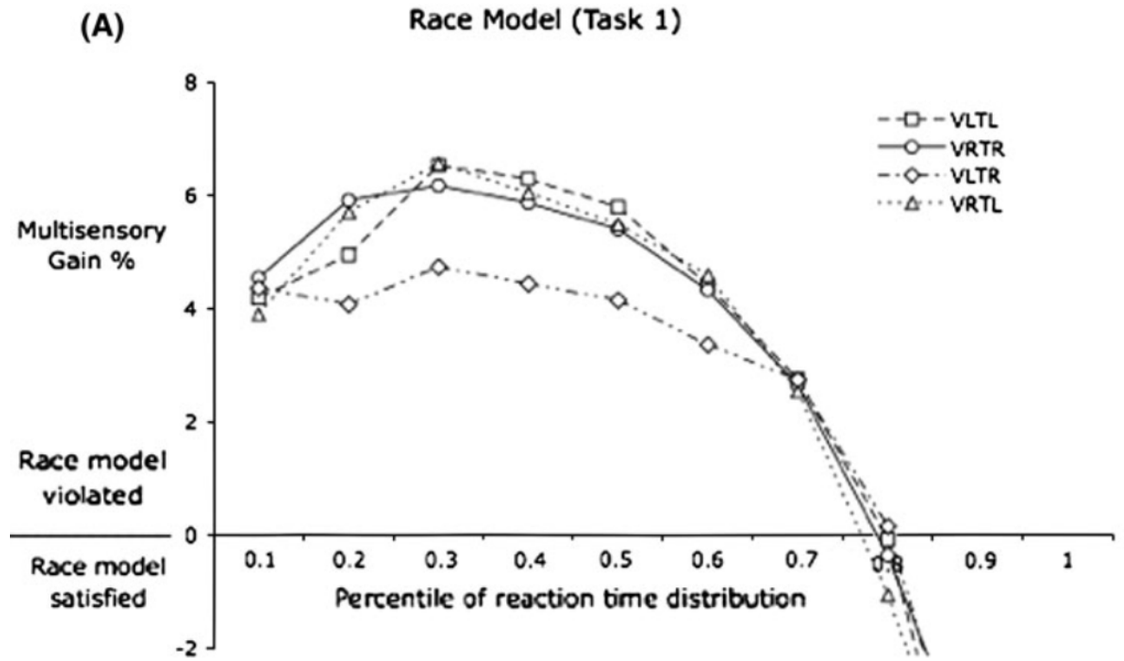

(A)
Mean Reaction Times
Visual
Tactile
Multisensory
Milliseconds
450
400
350
300
250
Aligned (VLTL)
Aligned (VRTR)
Misaligned (VLTR)
Misaligned (VRTL)

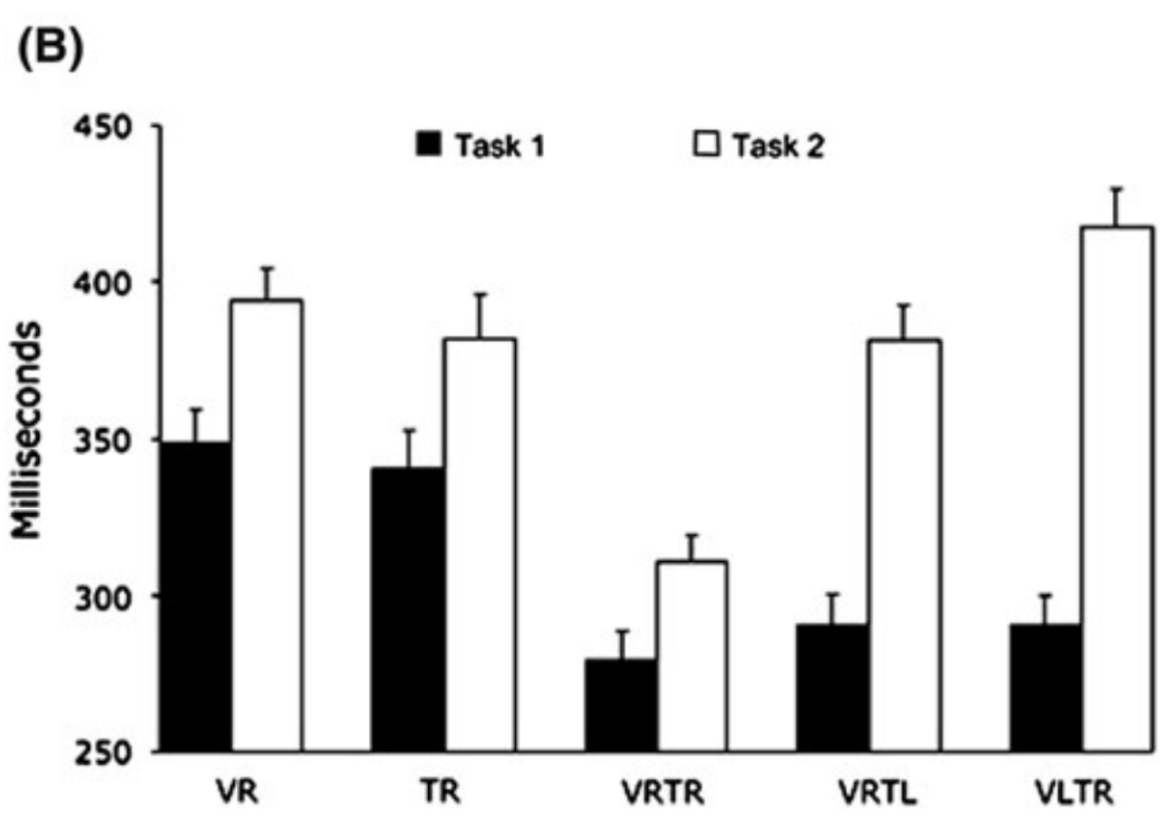


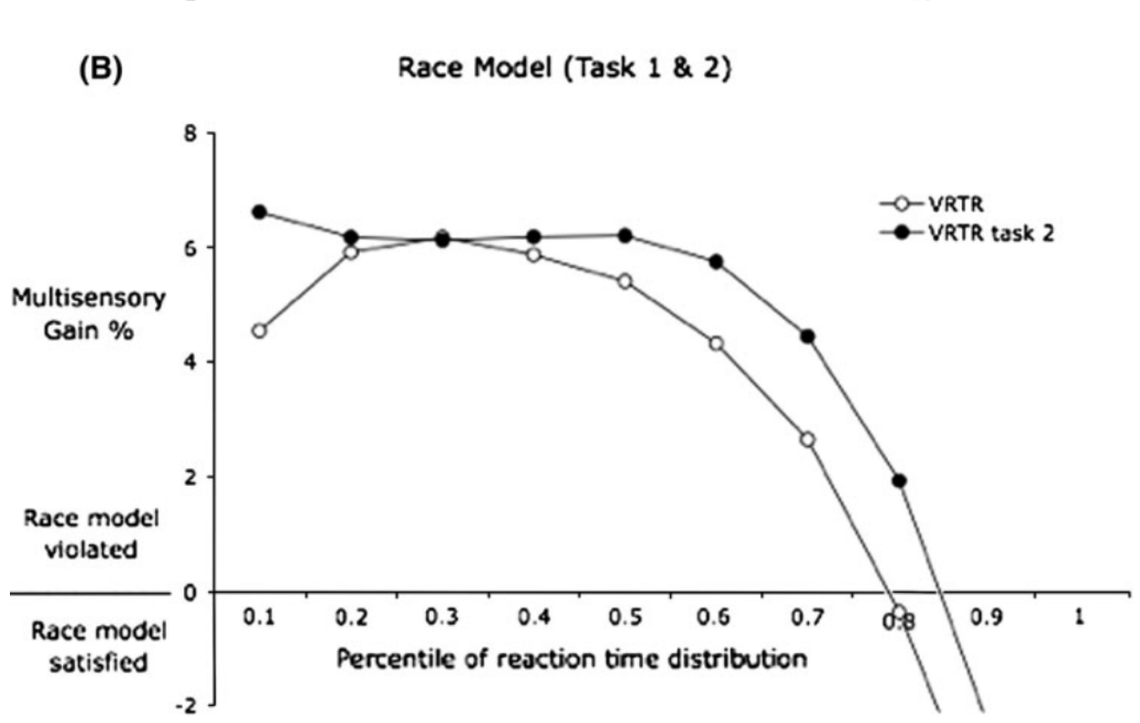


Girard et al. EBR 10

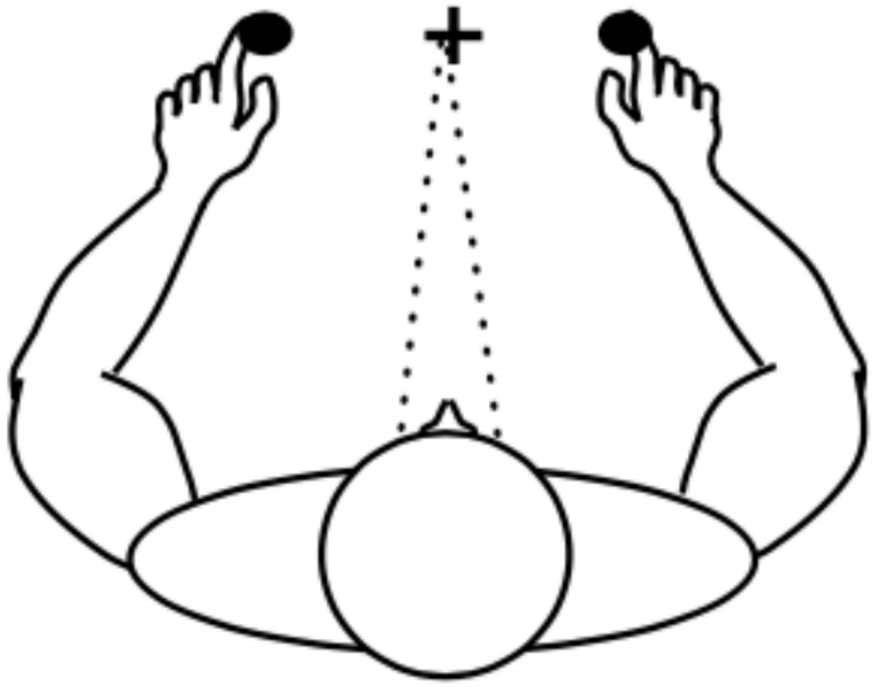




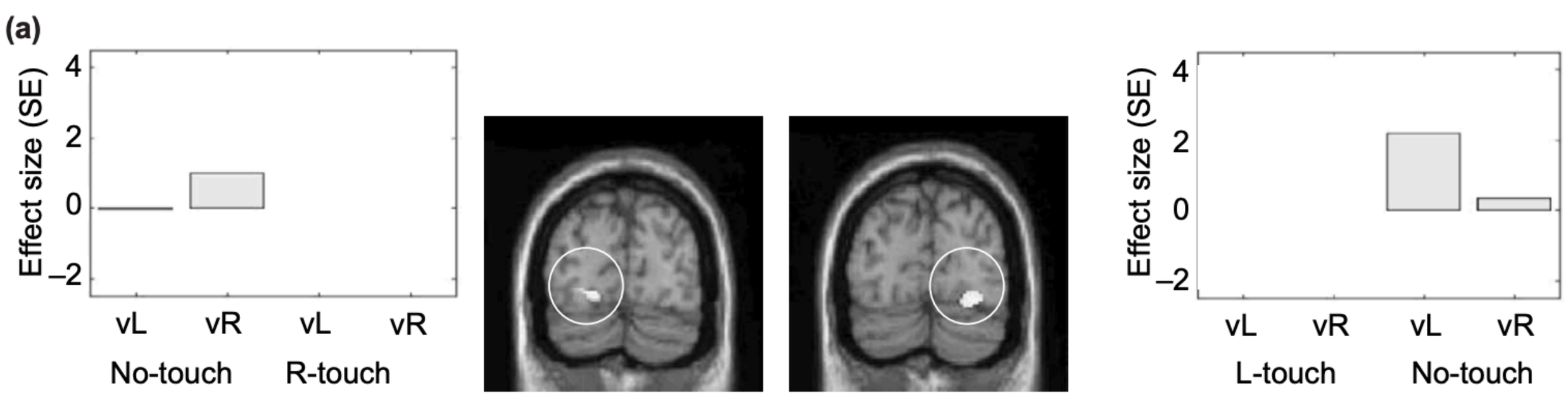




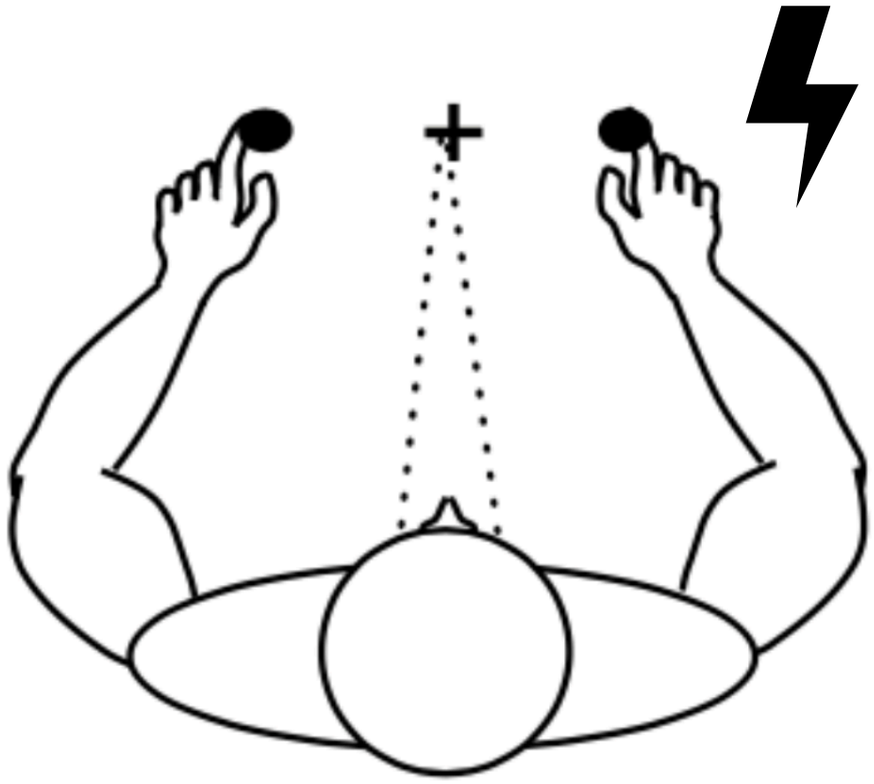
Girard et al. EBR 10



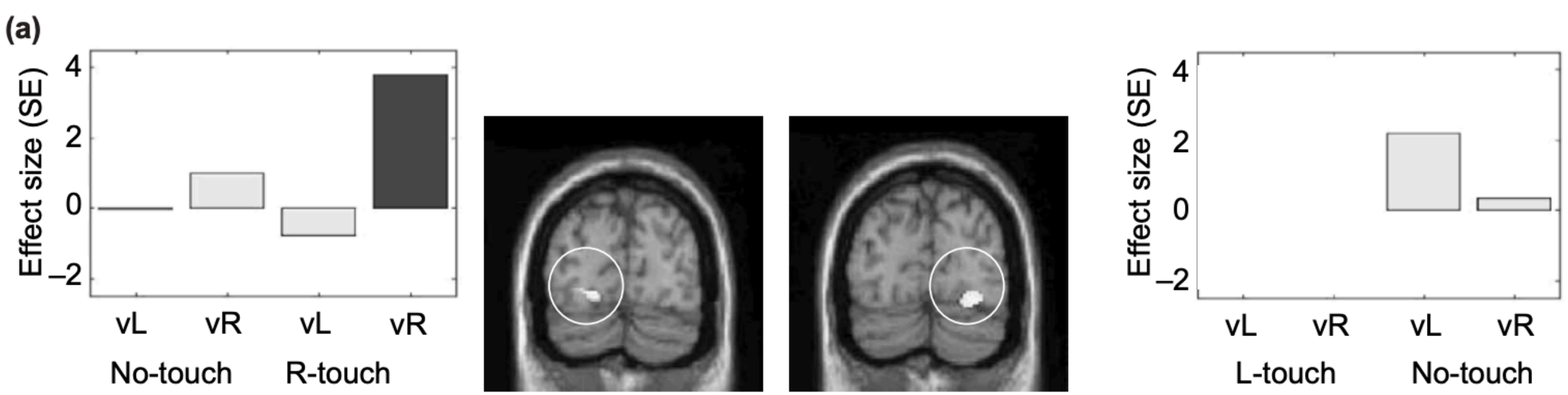
LEFT H. **RIGHT H.**



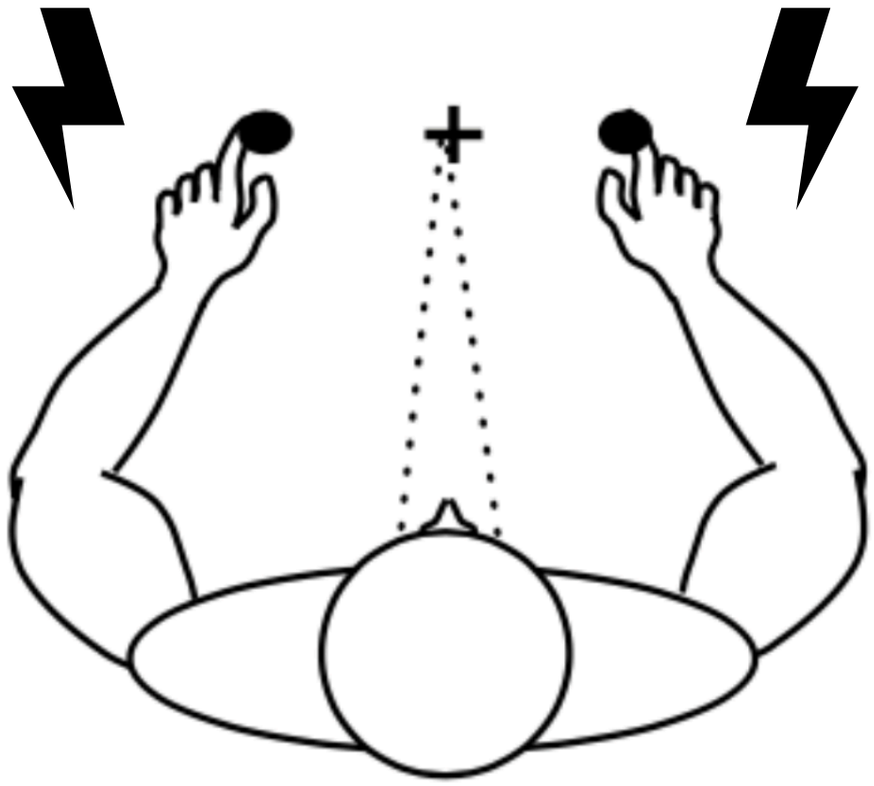
Macaluso et al. (2001)



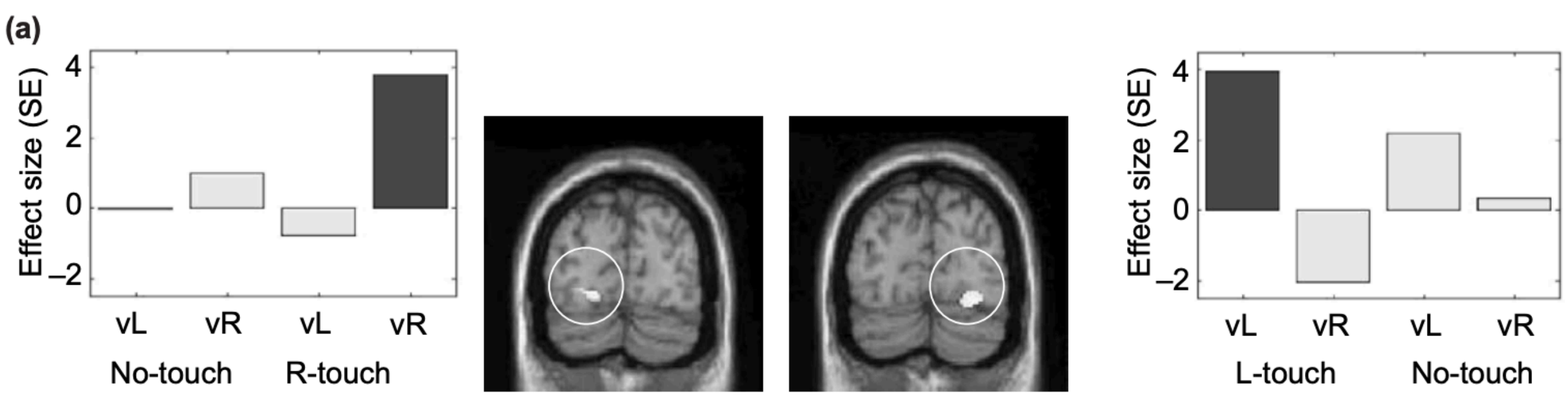
LEFT H. **RIGHT H.**



Macaluso et al. (2001)

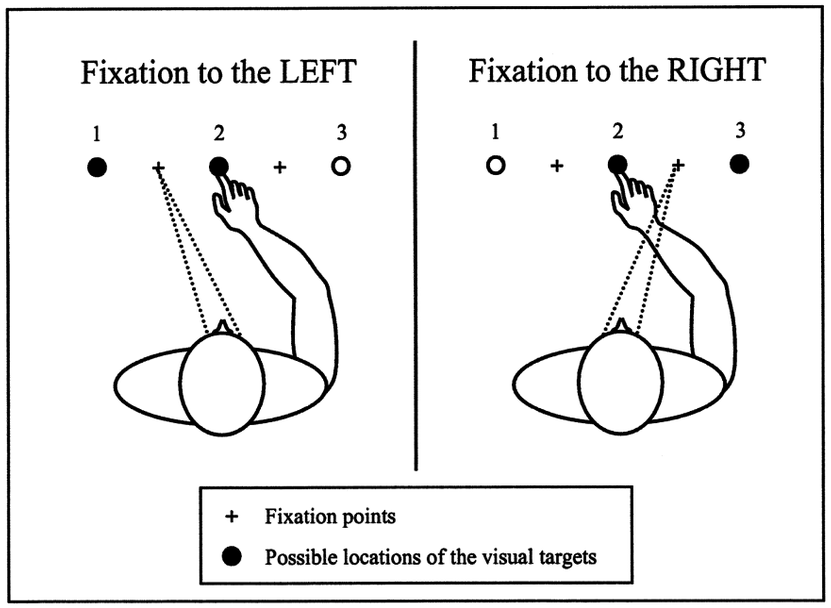


LEFT H. **RIGHT H.**



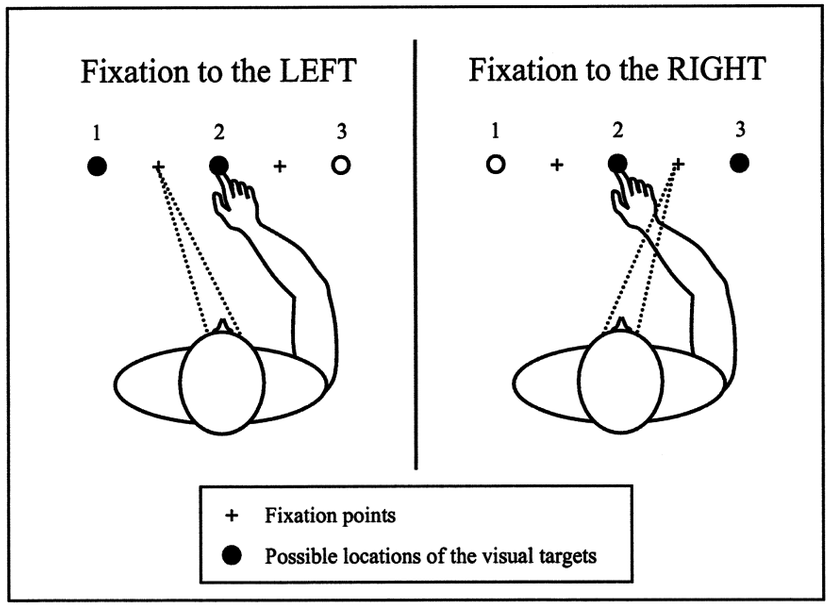
Macaluso et al. (2001)

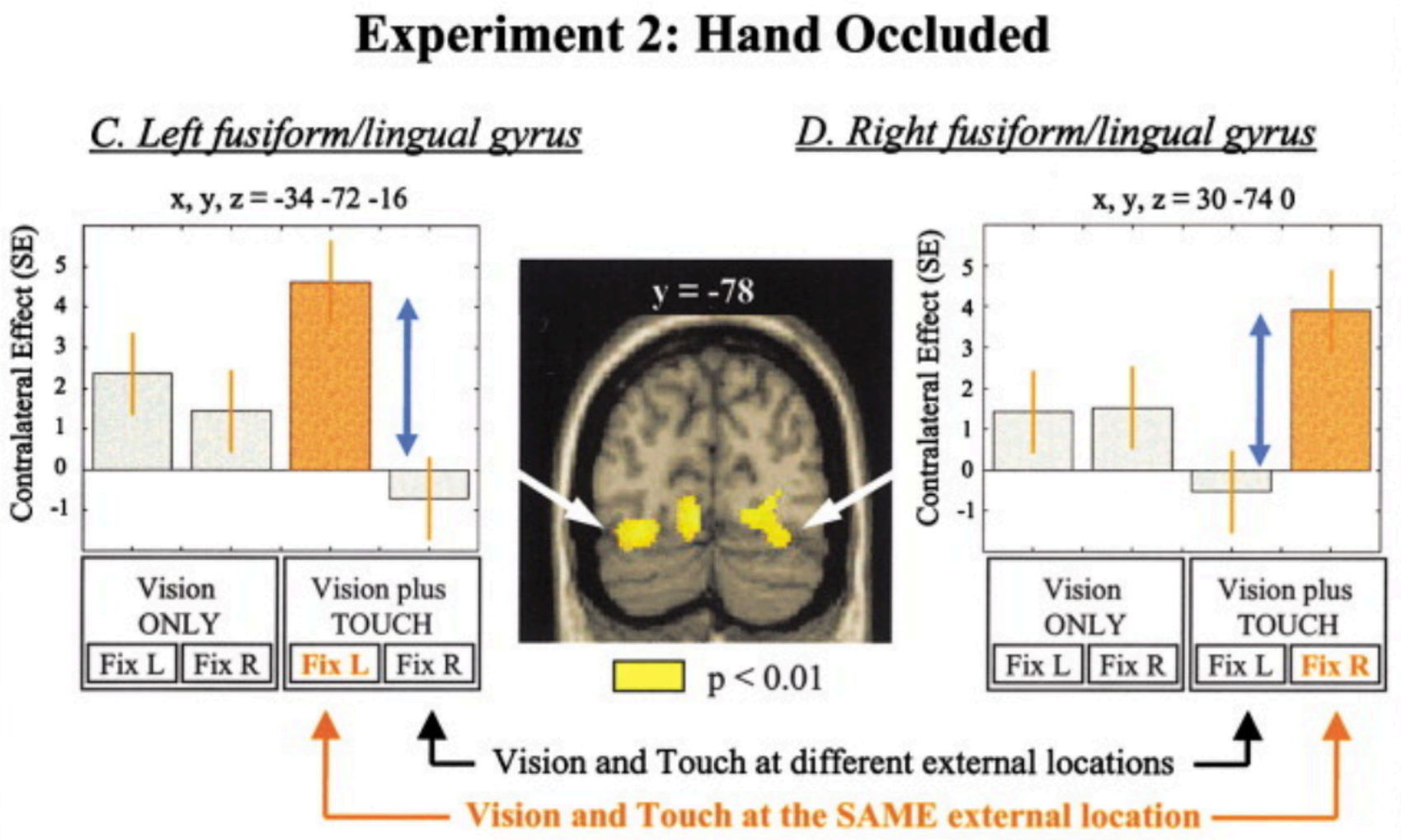
The shared location in external space determines crossmodal spatial effects



Macaluso et al. (2002)

The shared location in external space determines crossmodal spatial effects





Macaluso et al. (2002)

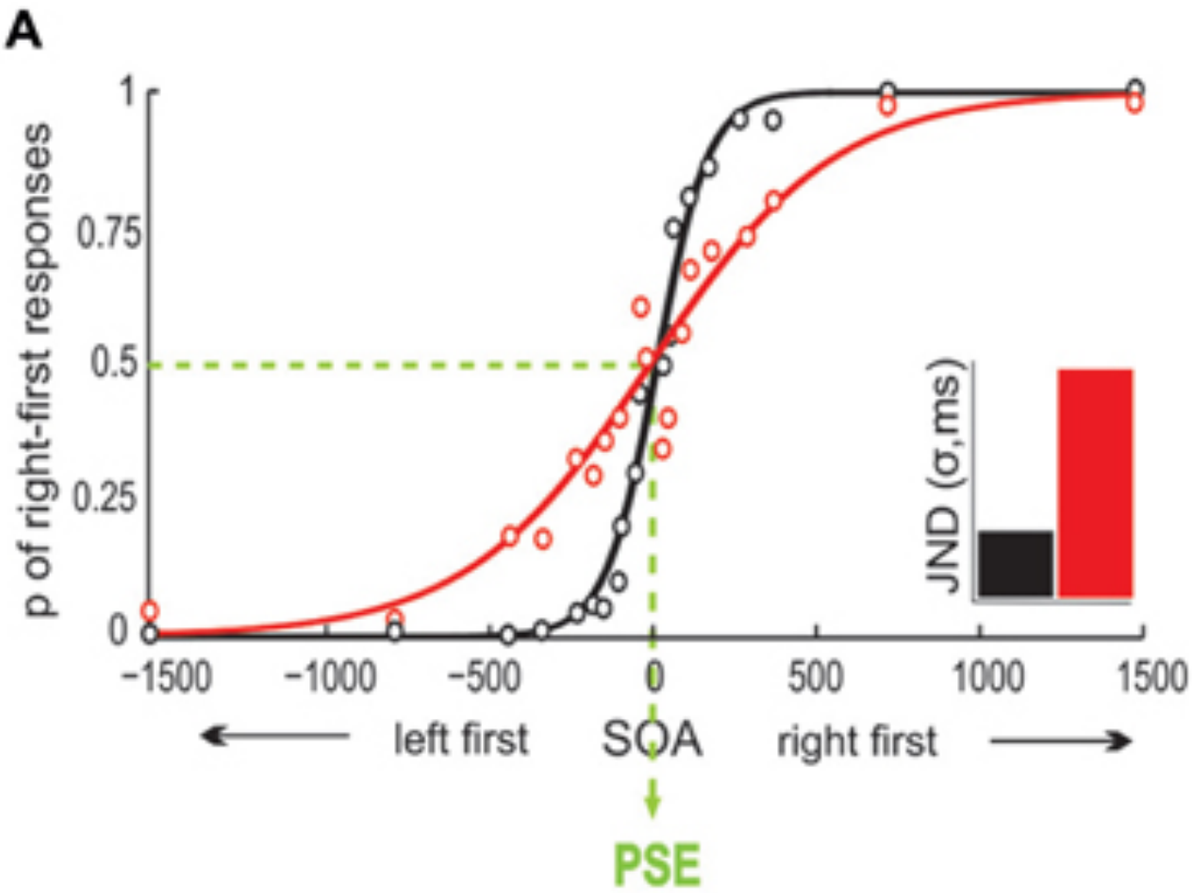
Automatic remapping of touch in external space?

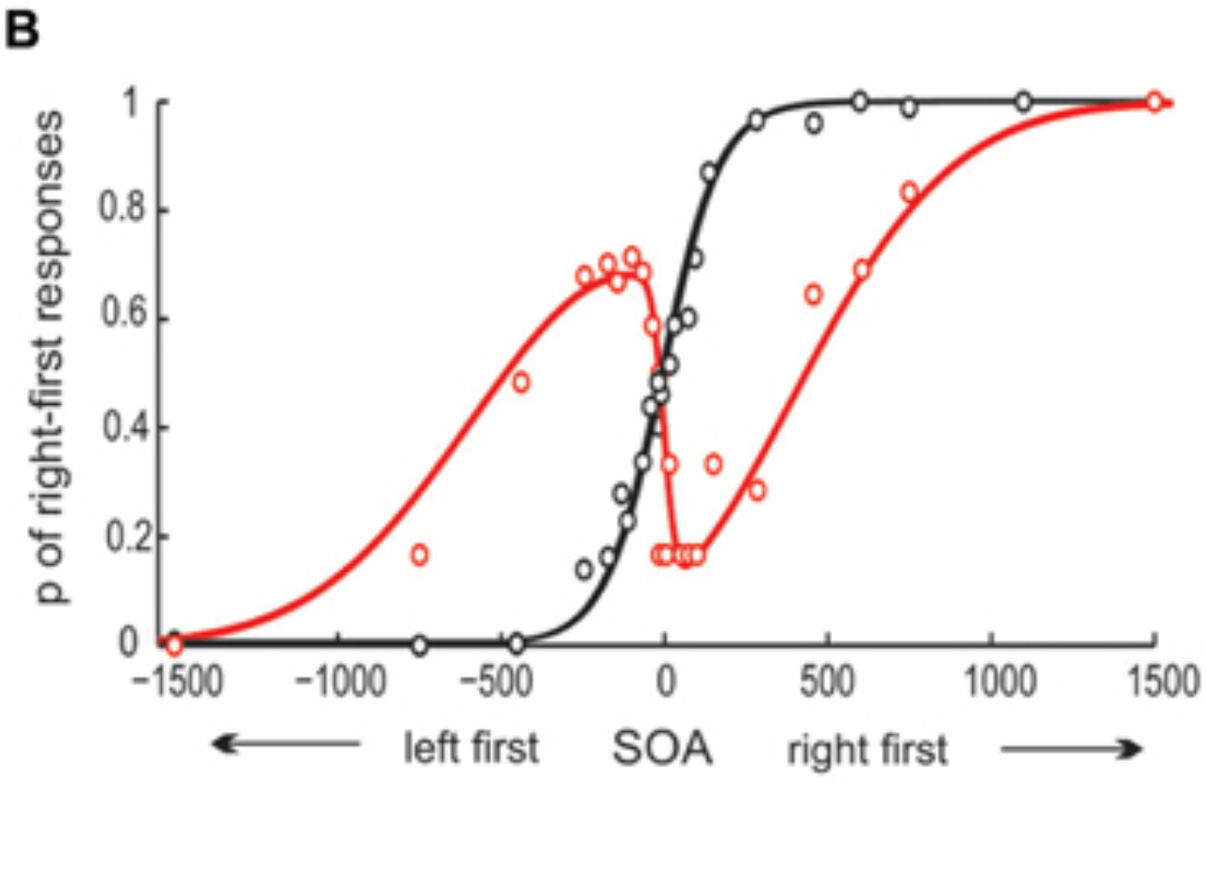
Tactile Temporal Order Judgement Task

Yamamoto & Kitazawa., Nat. Neuroscience (2001)

Heed & Azanon., FiP (2014)

Tactile Temporal Order Judgement Task

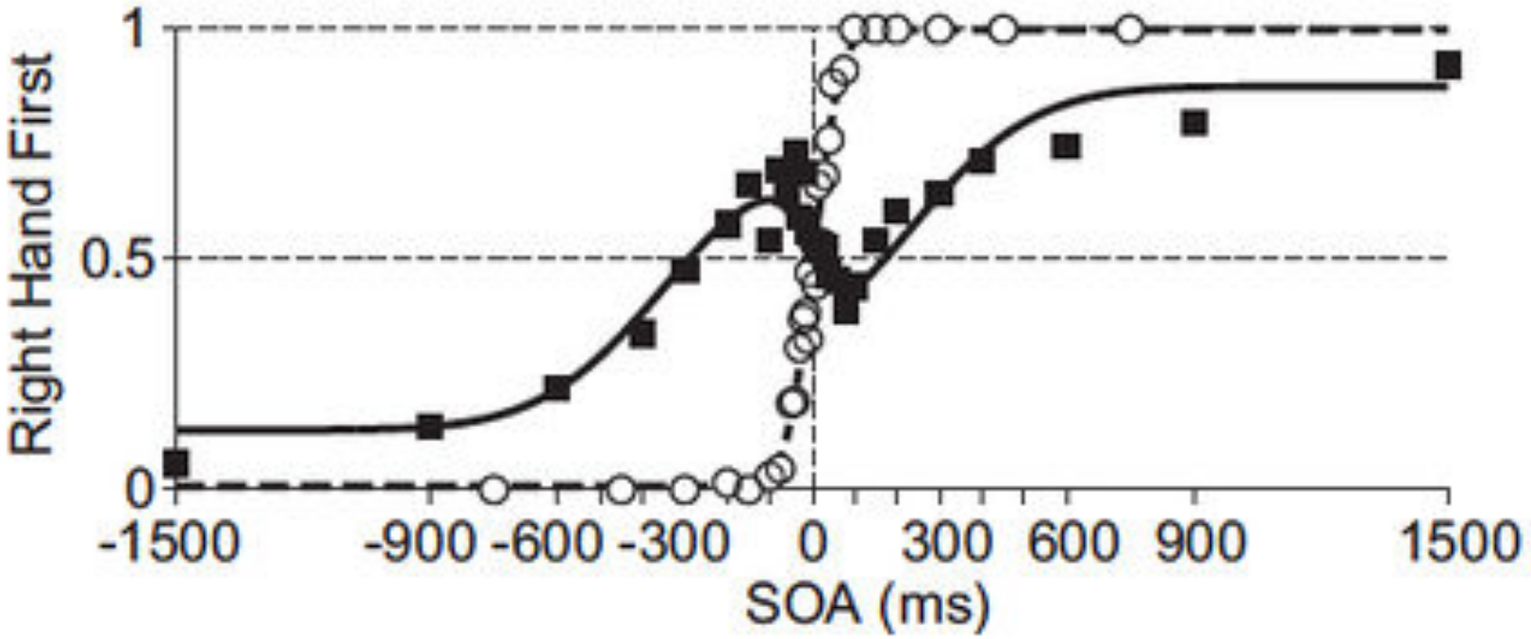




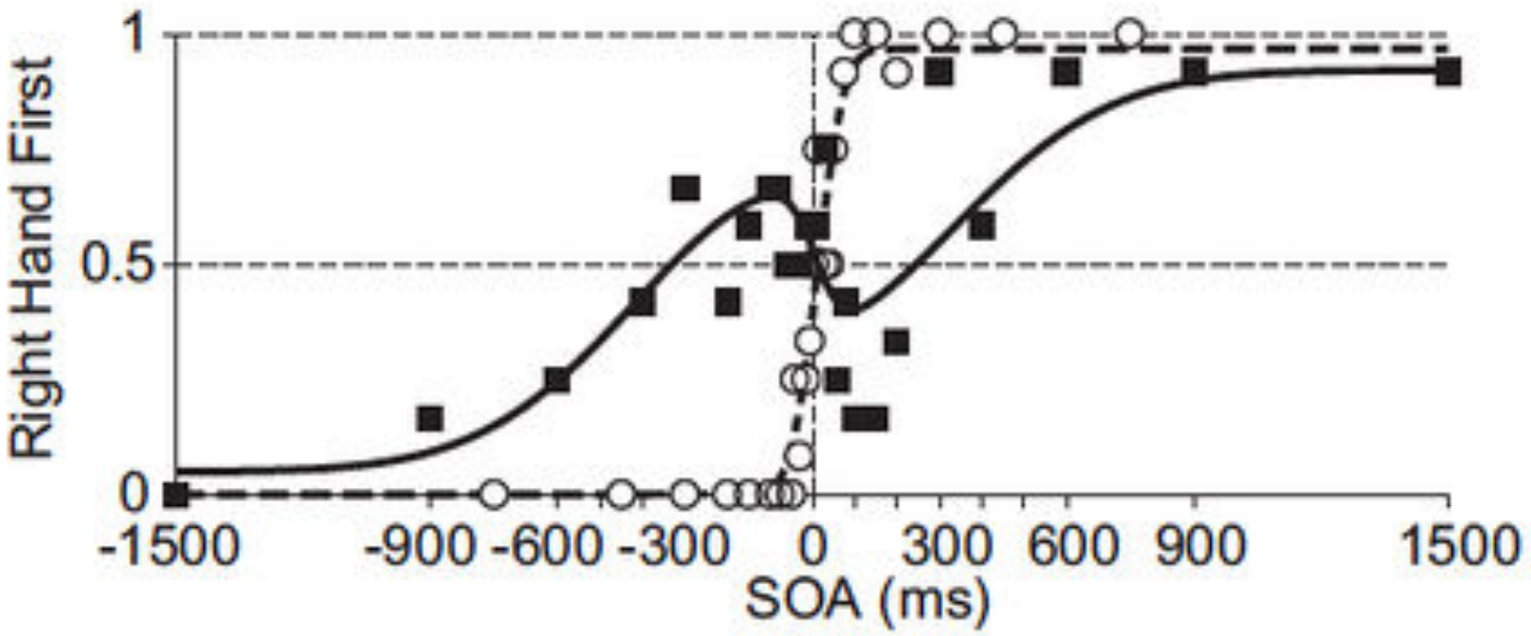
Yamamoto & Kitazawa., Nat. Neuroscience (2001)

Heed & Azanon., FiP (2014)

Crossing Hands



Crossing Sticks

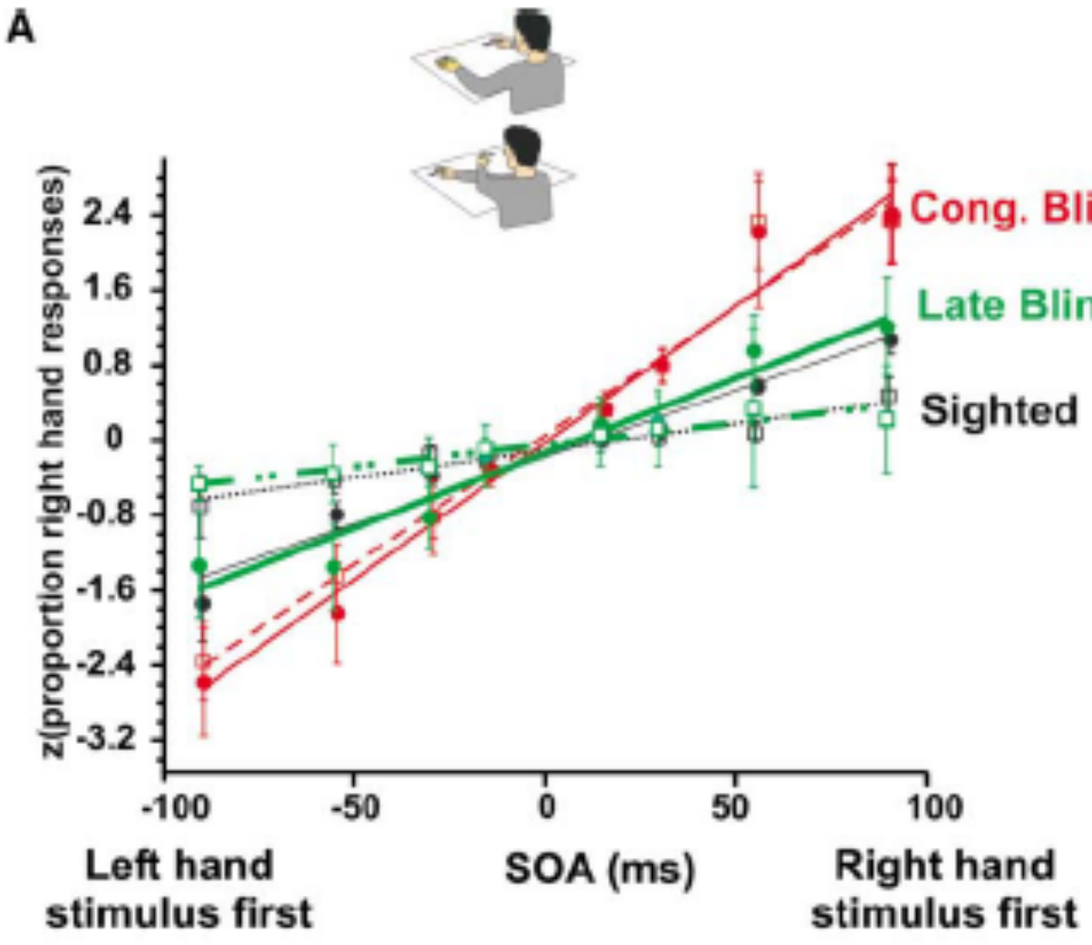


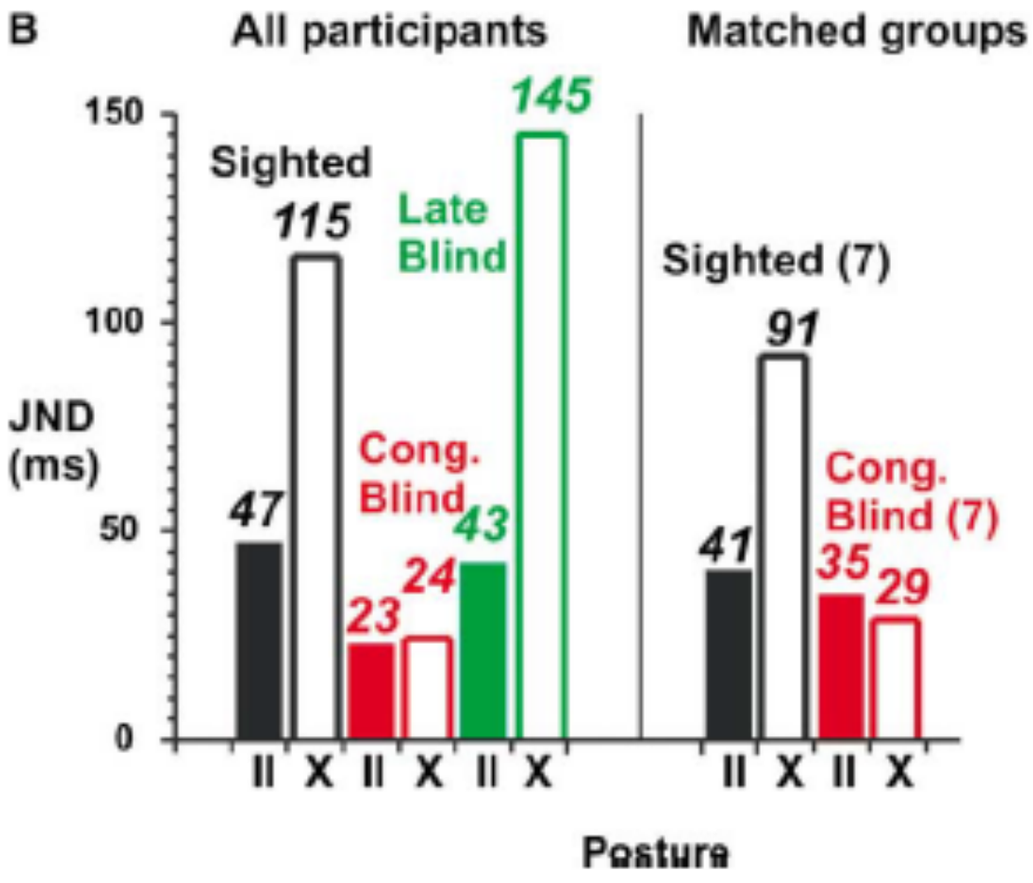
Yamamoto & Kitazawa., Scholarpedia (2015)

Why?

> Remap somatosensory coordinate onto external coordinate for VISION

External remapping of touch in the blind



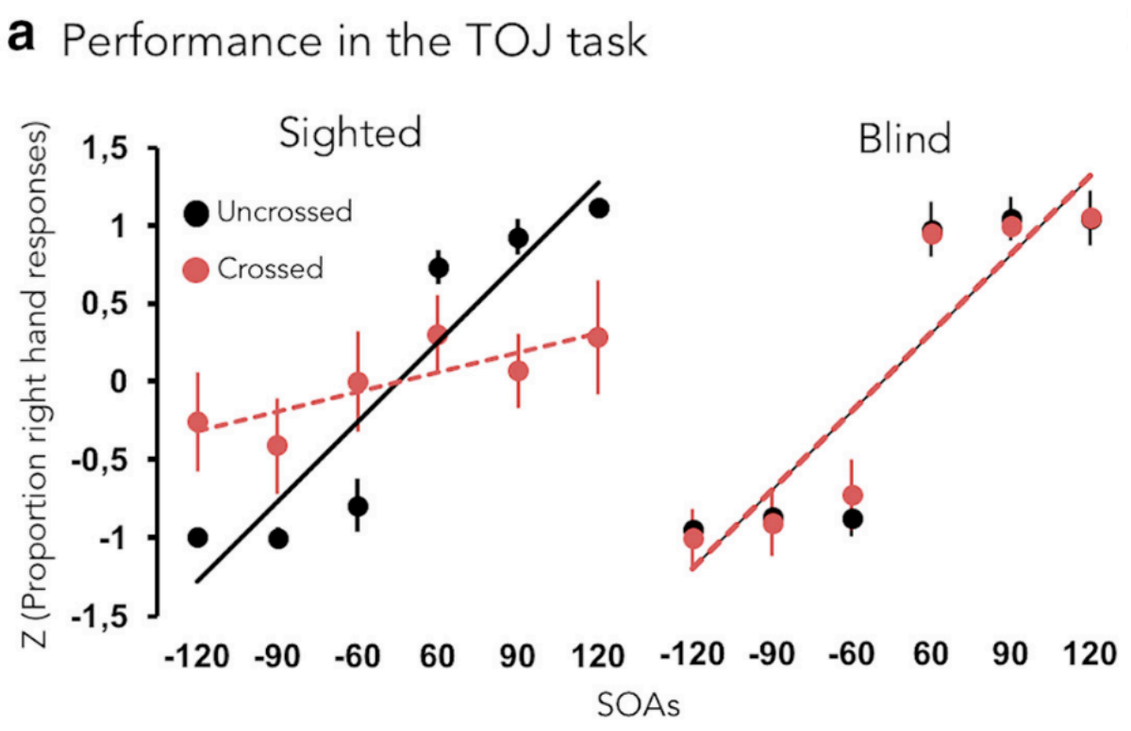


Roder et al., CB (2004)

Neural correlates of the external remapping of touch in the blind

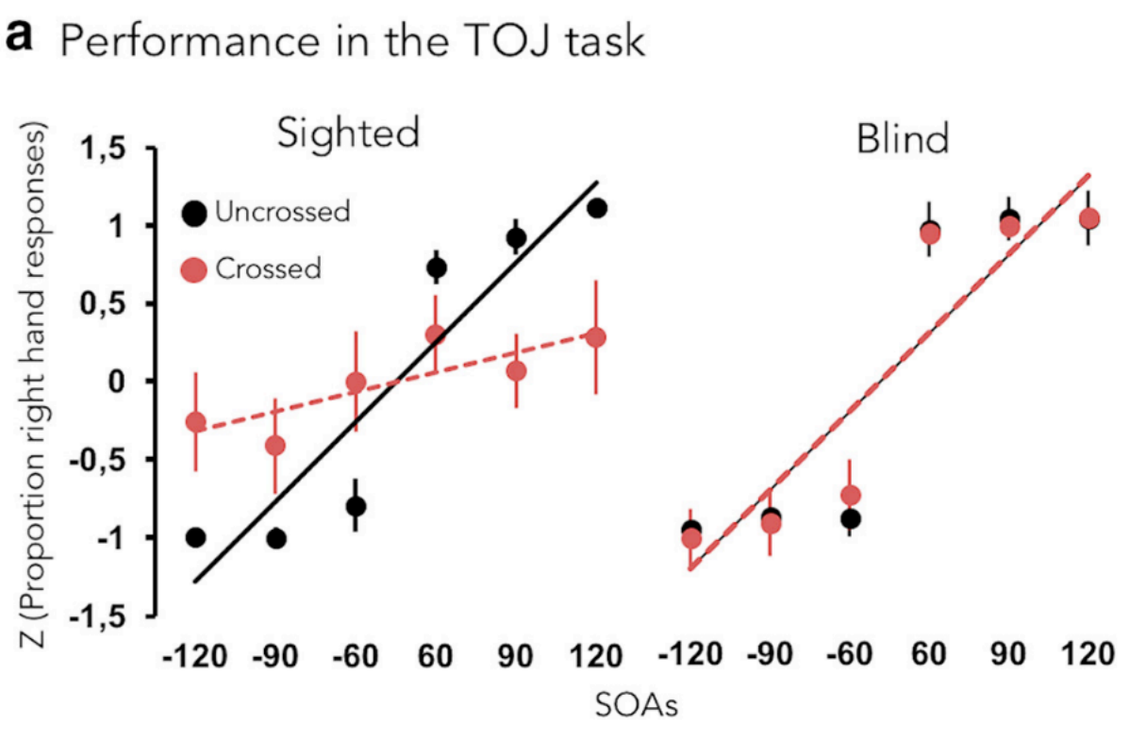
Crollen et al., J. Neuroscience (2017)

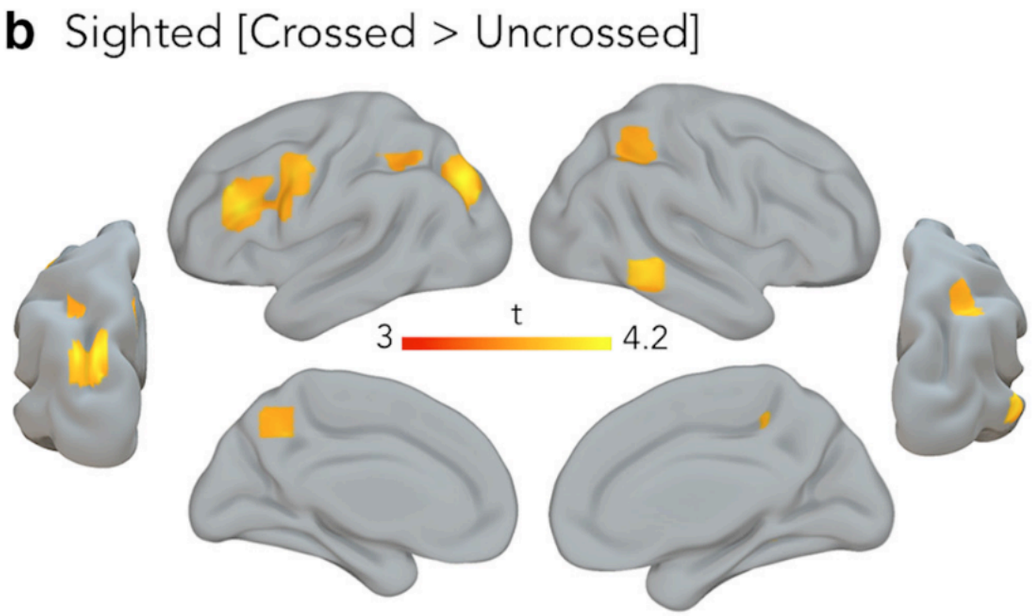
Neural correlates of the external remapping of touch in the blind



Crollen et al., J. Neuroscience (2017)

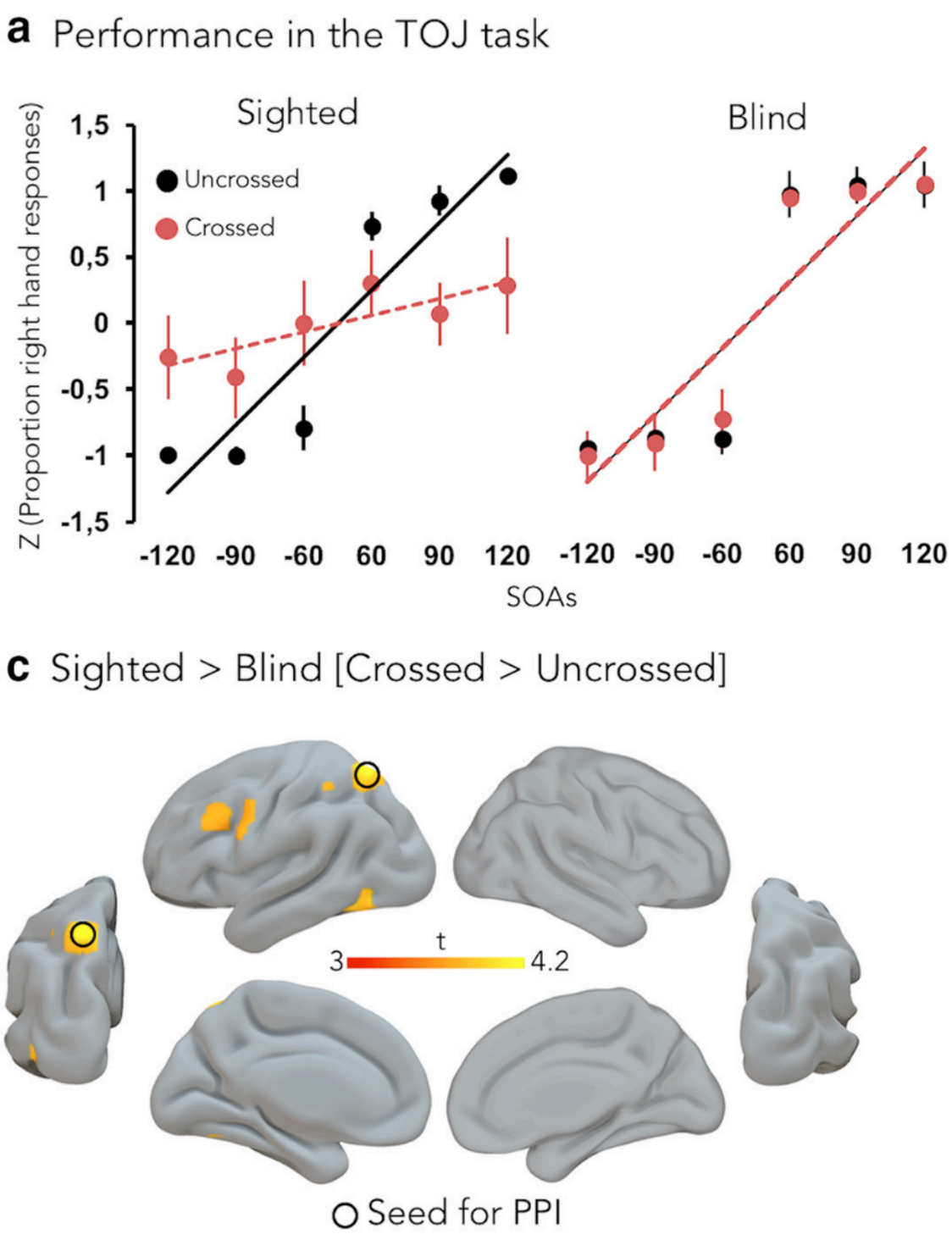
Neural correlates of the external remapping of touch in the blind





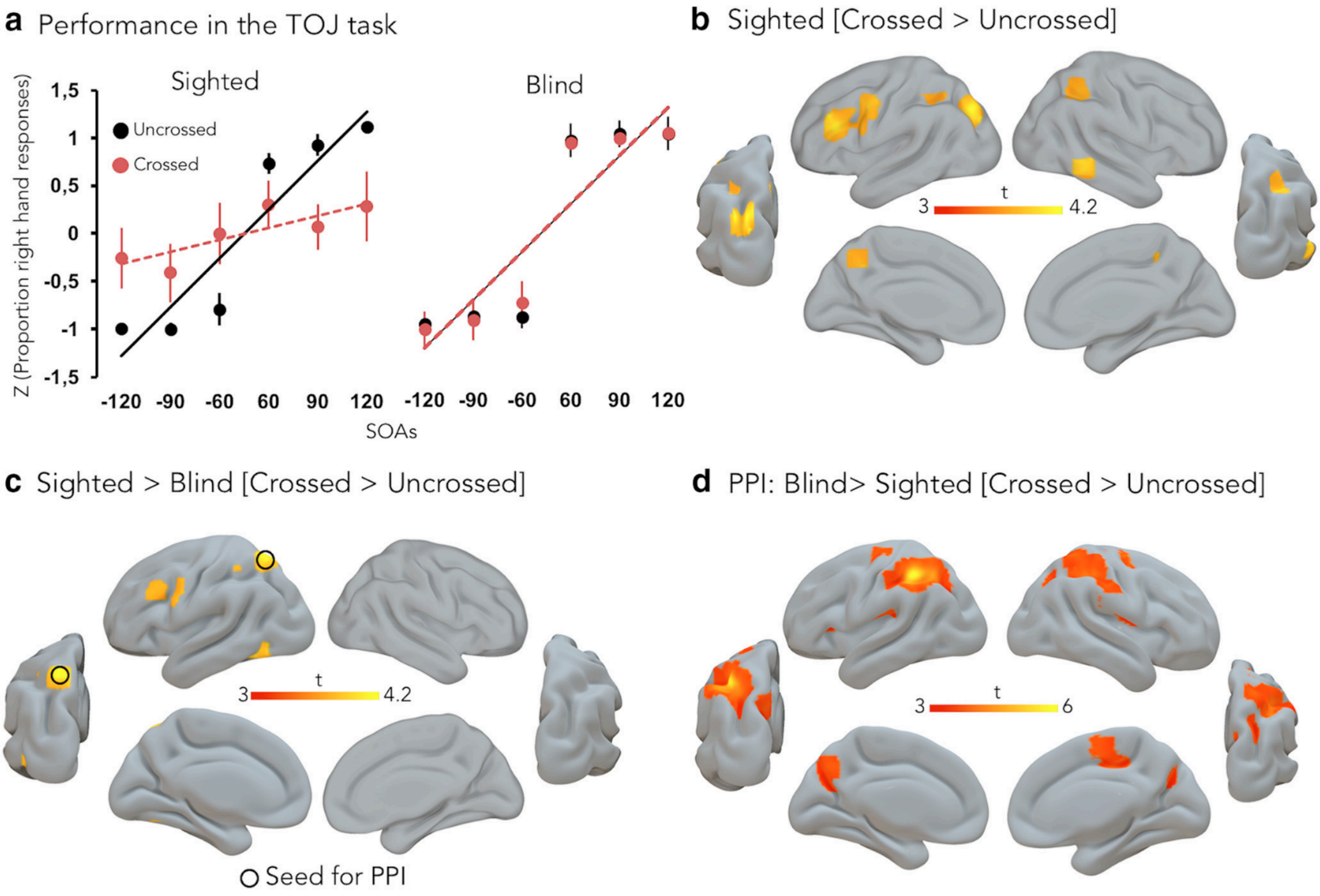
Crollen et al., J. Neuroscience (2017)

Neural correlates of the external remapping of touch in the blind



Crollen et al., J. Neuroscience (2017)

Neural correlates of the external remapping of touch in the blind



Crollen et al., J. Neuroscience (2017)

"High-level"

Visuo-Tactile integration

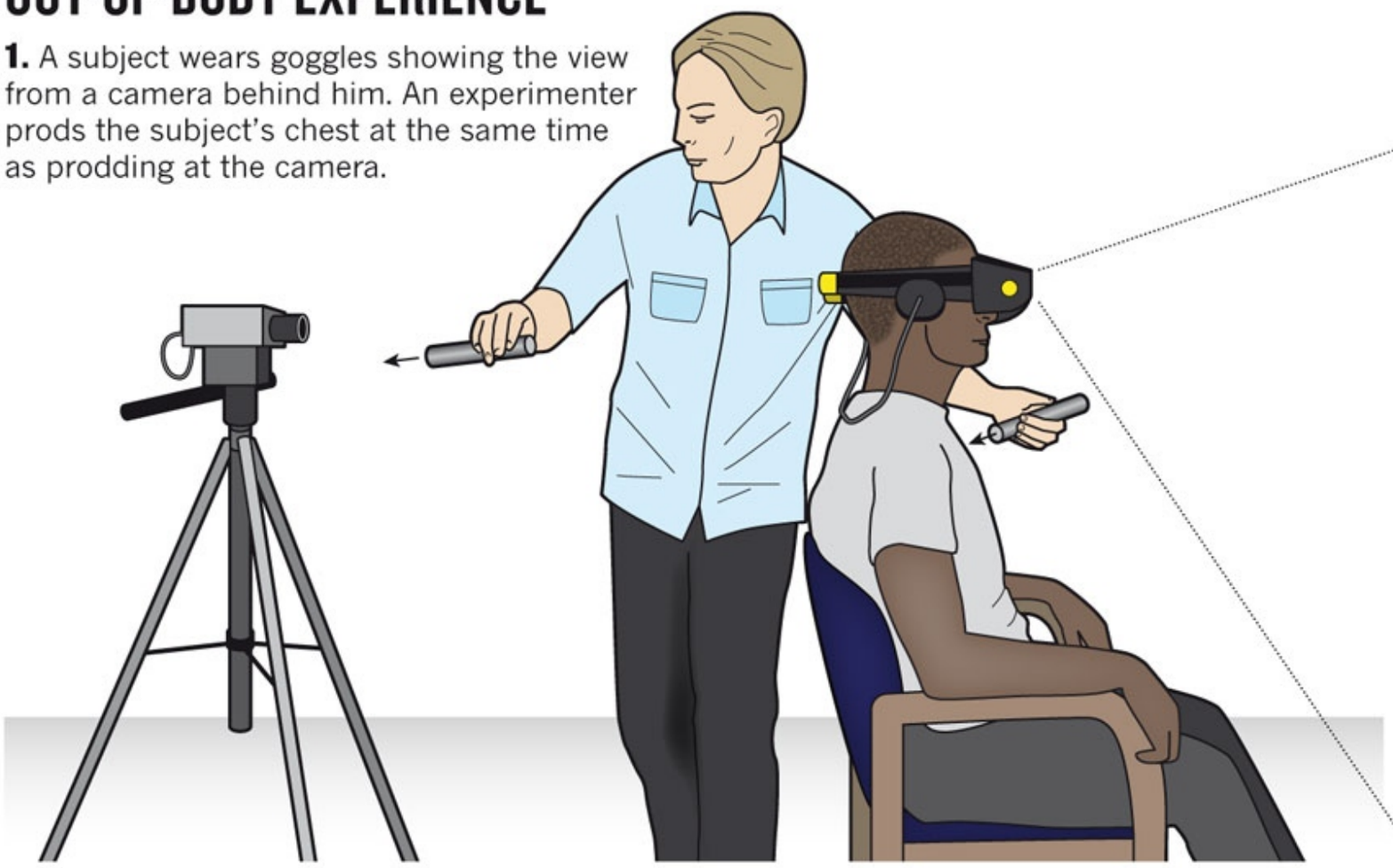
[Body Perception]

Rubber Hand Illusion

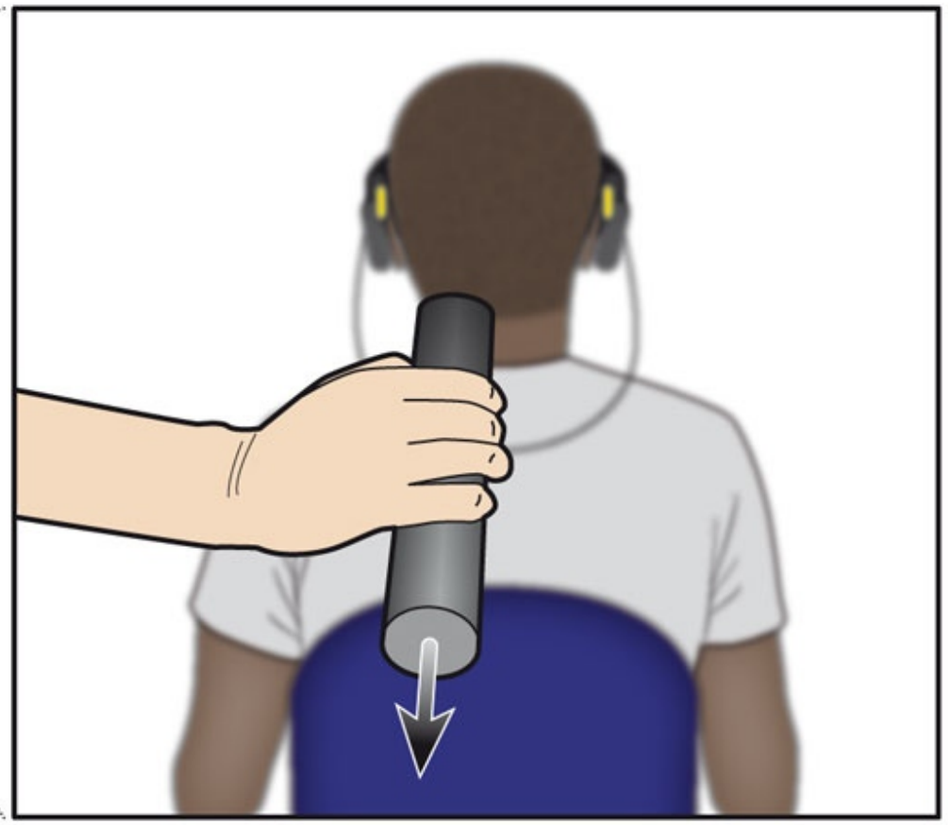
Out of Body Experiment

OUT-OF-BODY EXPERIENCE

1. A subject wears goggles showing the view from a camera behind him. An experimenter prods the subject's chest at the same time as prodding at the camera.



2. The subject sees the hand prodding towards the camera as he feels his chest being prodded. He also sees his body from behind. This creates a vivid sense that his real body is floating behind the one he sees.



Out of Body Experiment

Out of Body Experiment

"High-level"

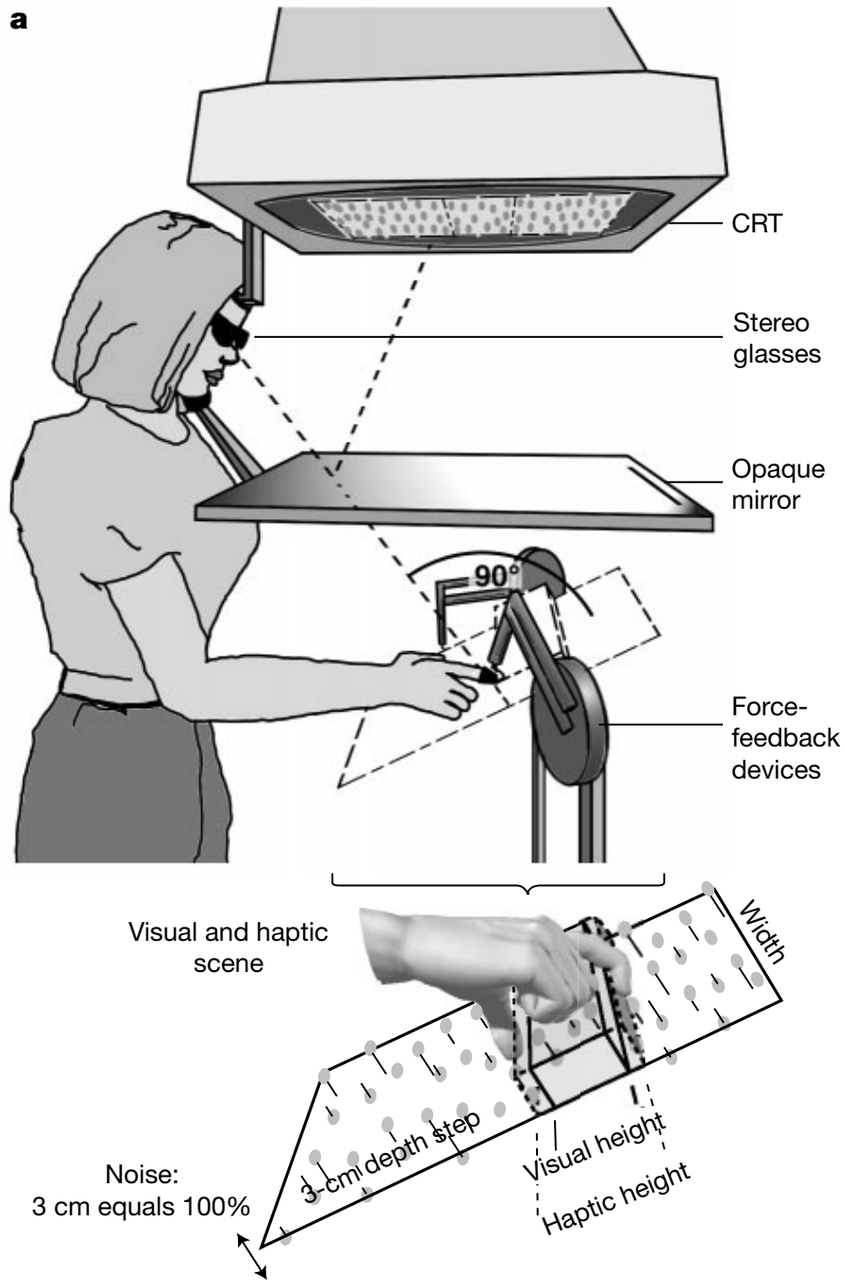
Visuo-Tactile integration

[Shape Perception]

Humans integrate visual and haptic information in a statistically optimal fashion

Marc O. Ernst* & Martin S. Banks

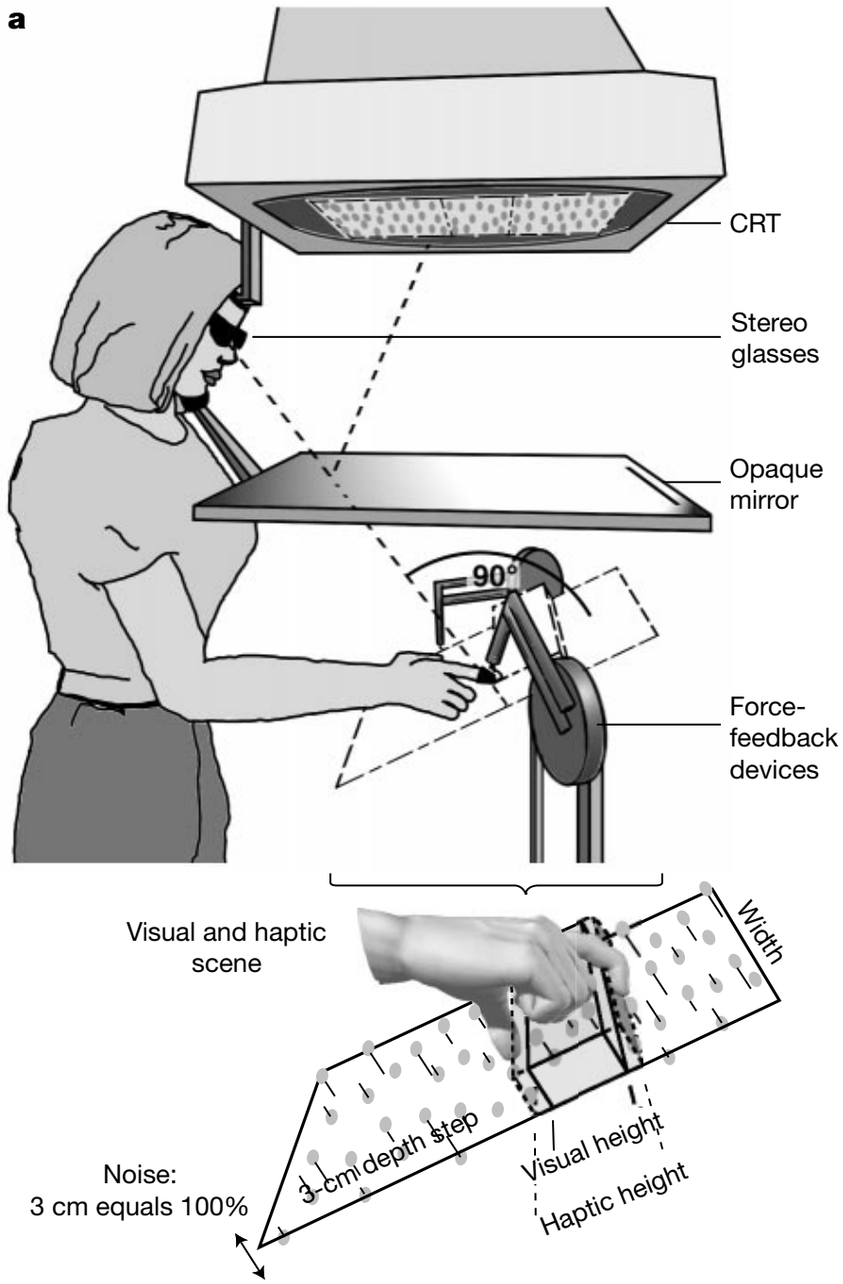
Vision Science Program/School of Optometry, University of California, Berkeley 94720-2020, USA

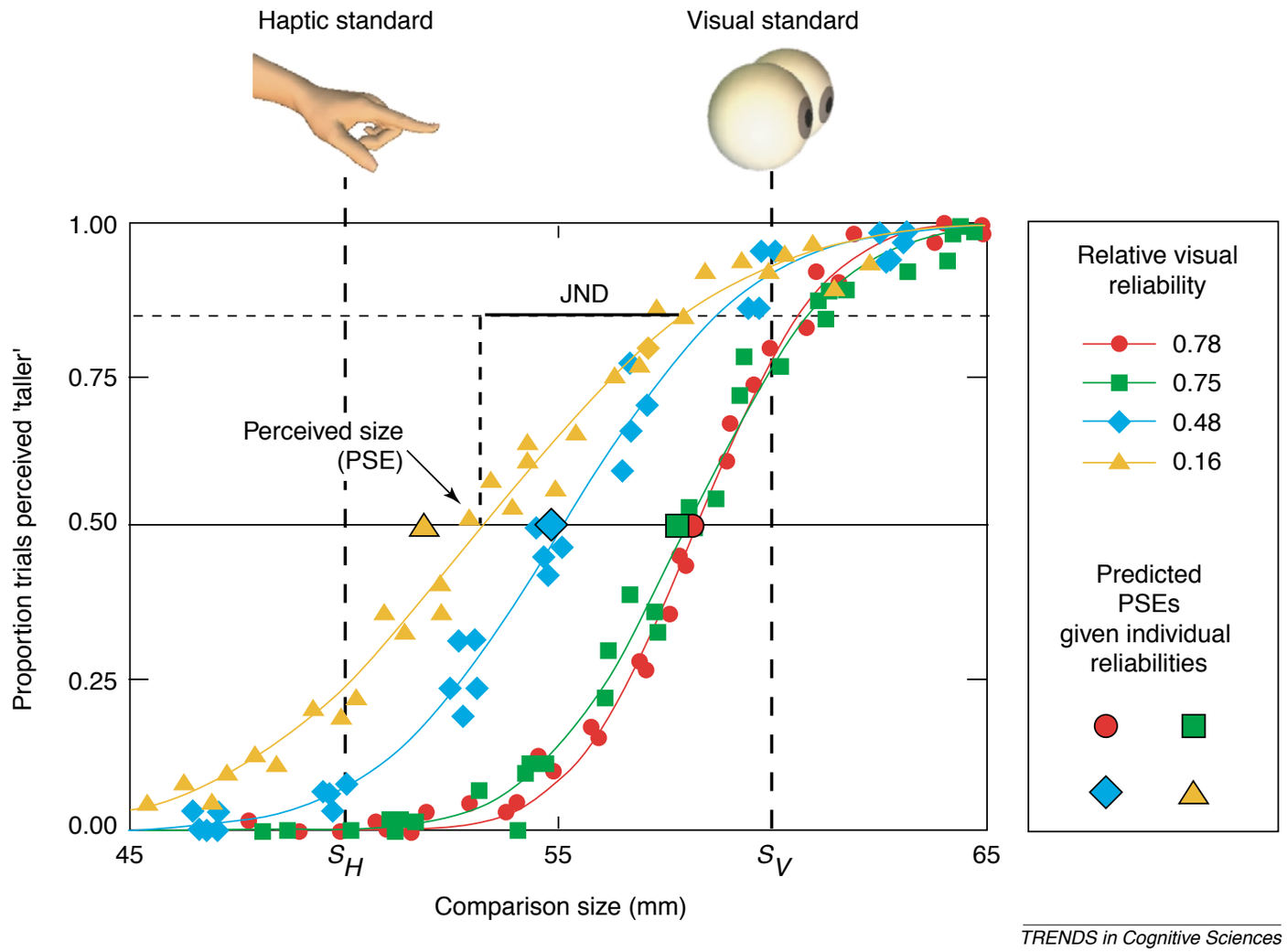


Humans integrate visual and haptic information in a statistically optimal fashion

Marc O. Ernst* & Martin S. Banks

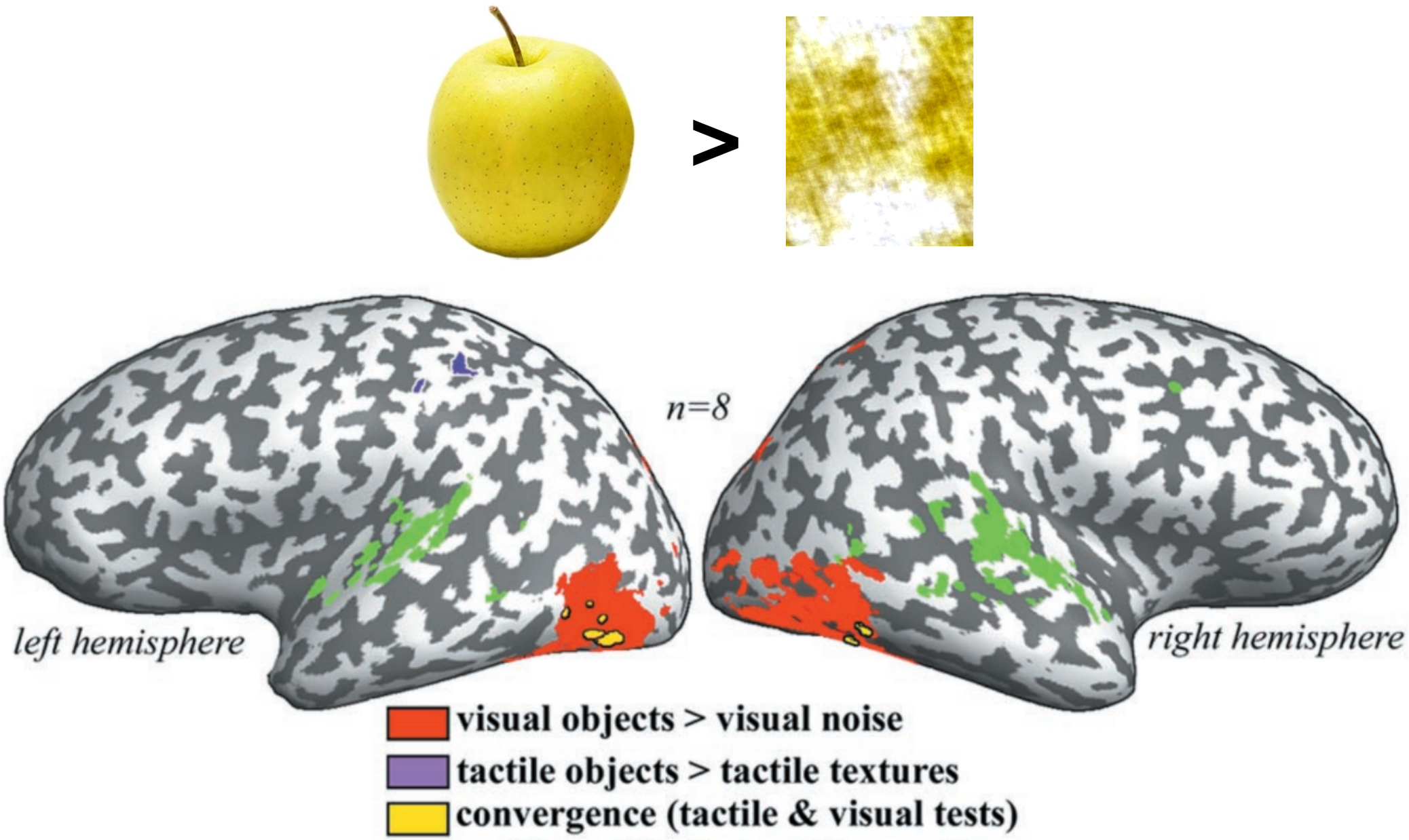
Vision Science Program/School of Optometry, University of California, Berkeley 94720-2020, USA





TRENDS in Cognitive Sciences

Convergence of visual and tactile object recognition



Amedi et al., Nat. Neuroscience (2002)

Is the lateral occipito-temporal cortex encoding supramodal shape

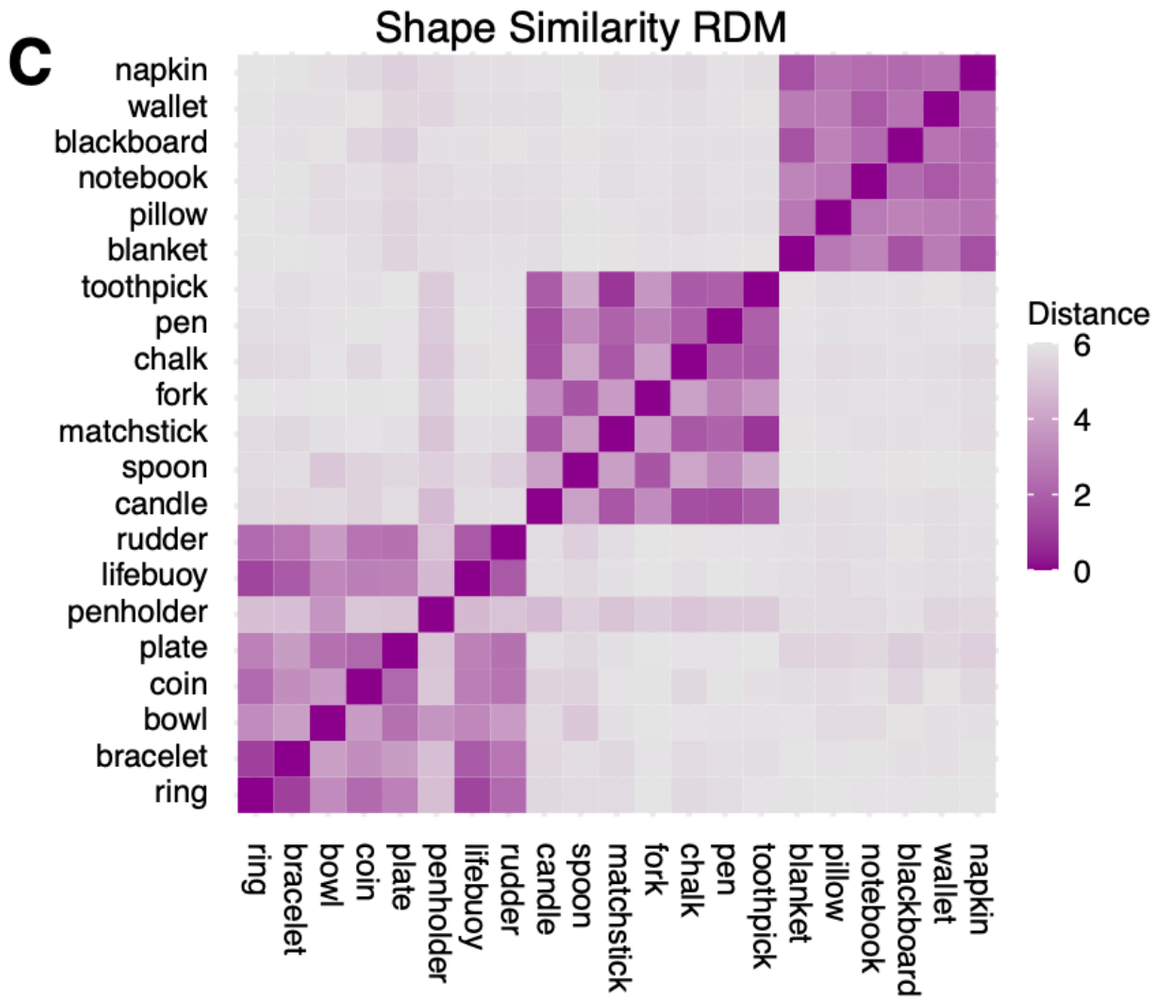
or

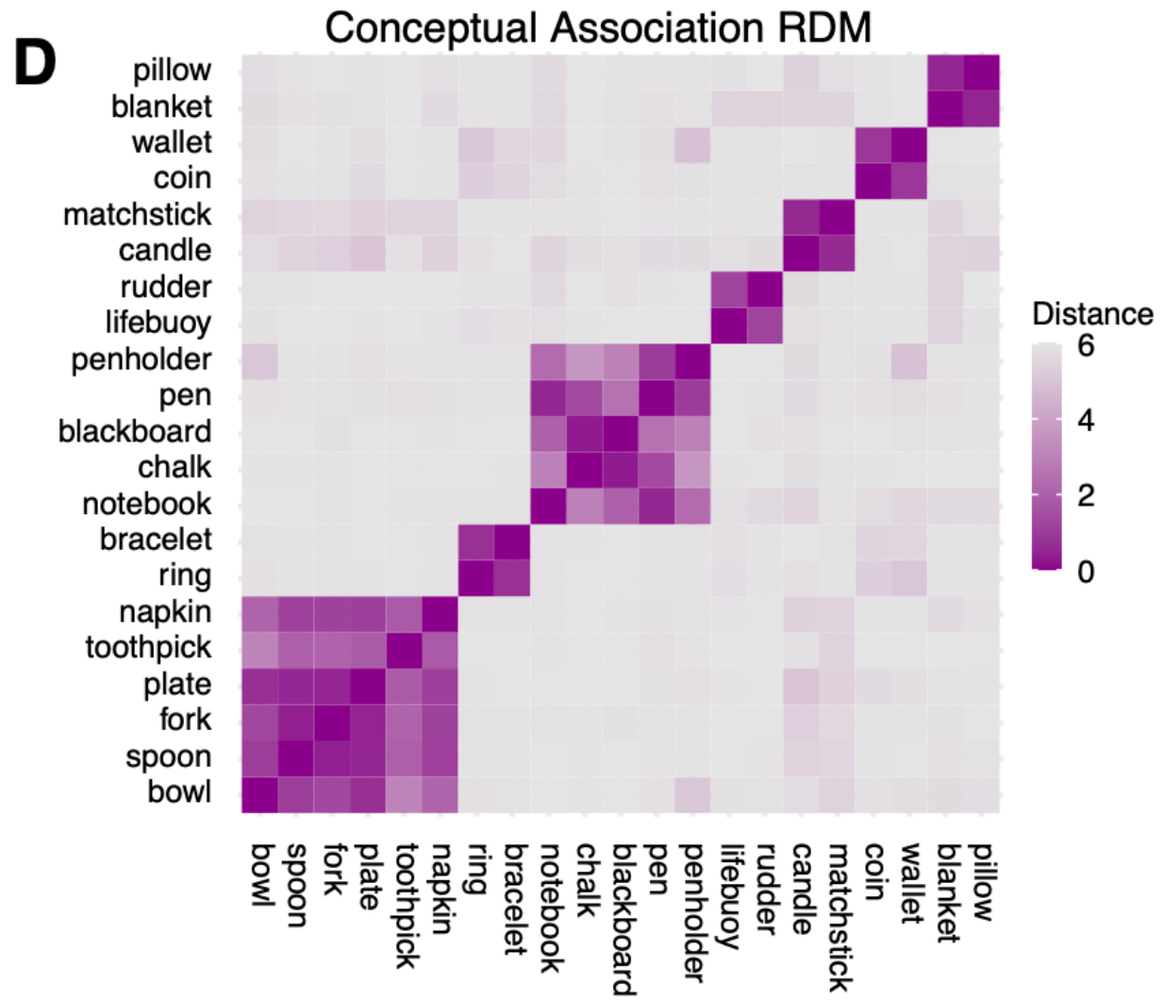
Semantic representation of objects

or

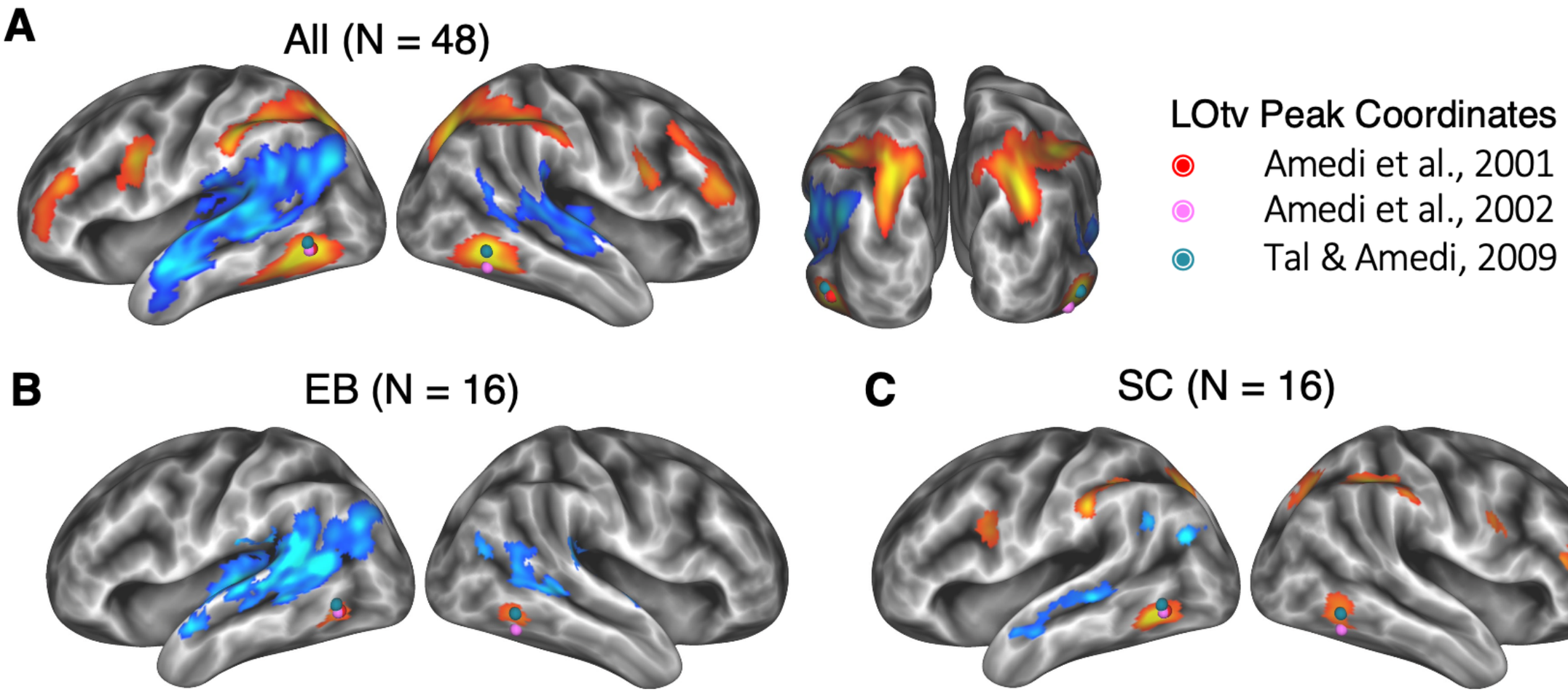
Visual imagery

Supramodal shape representation in the human brain?

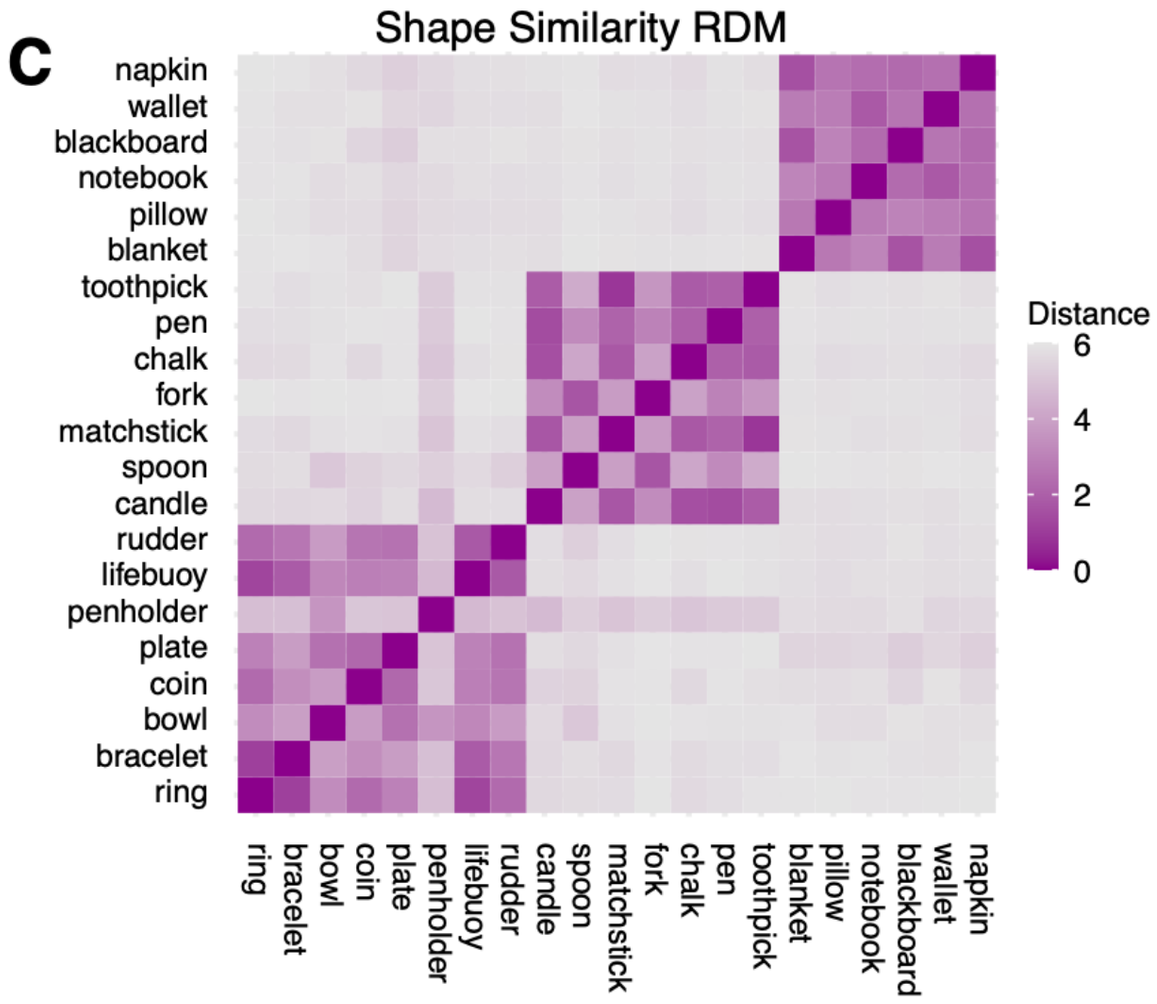


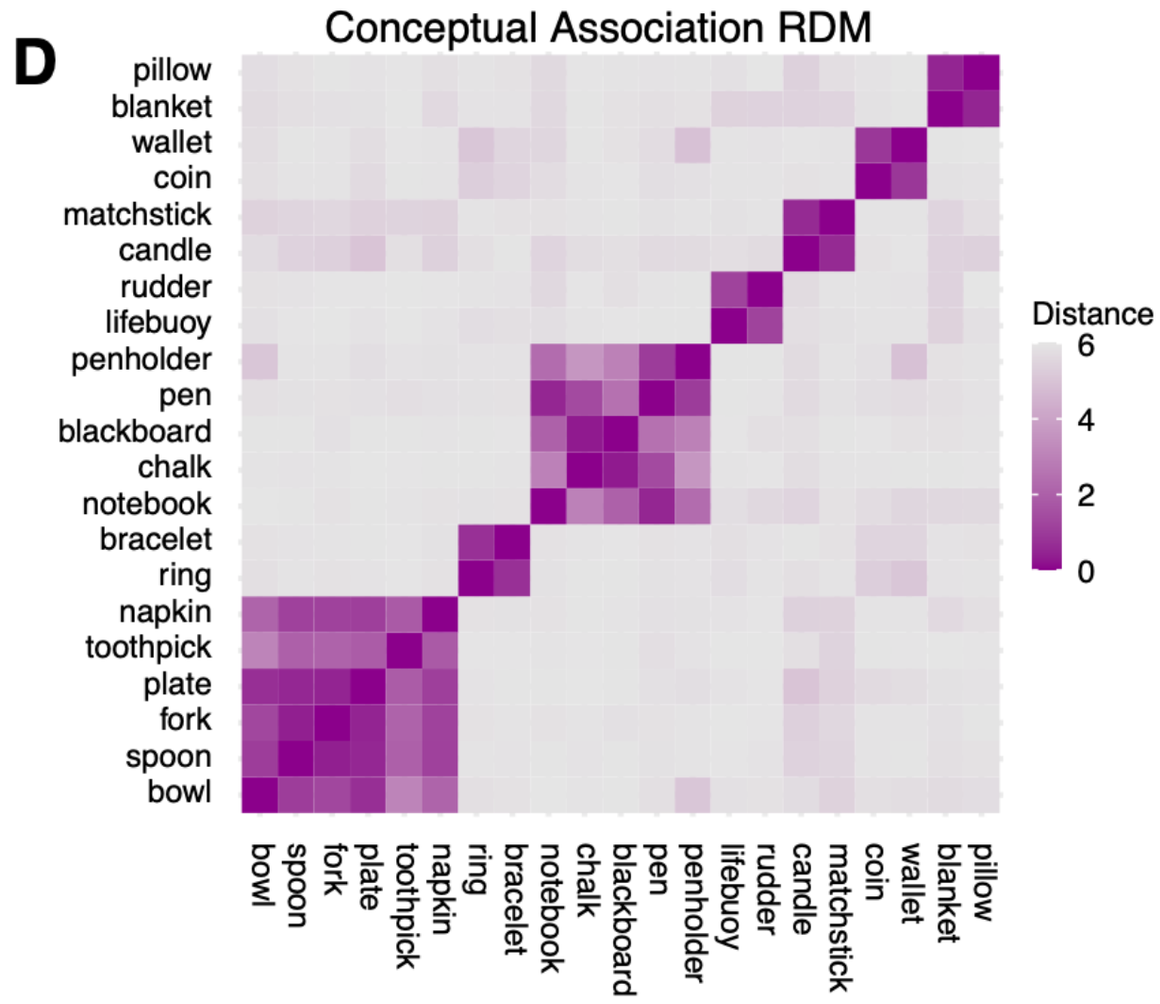


Supramodal shape representation in the human brain?



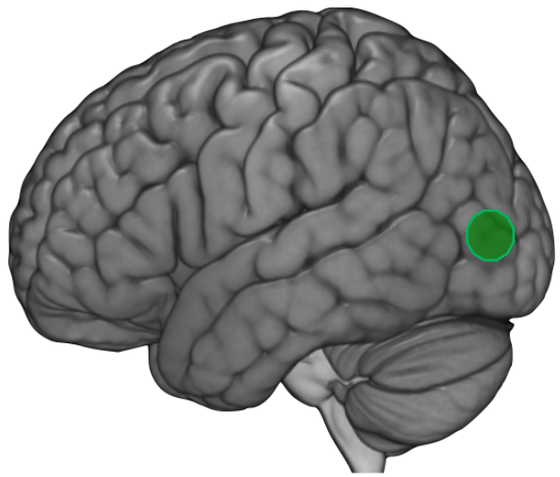
Supramodal shape representation in the human brain?



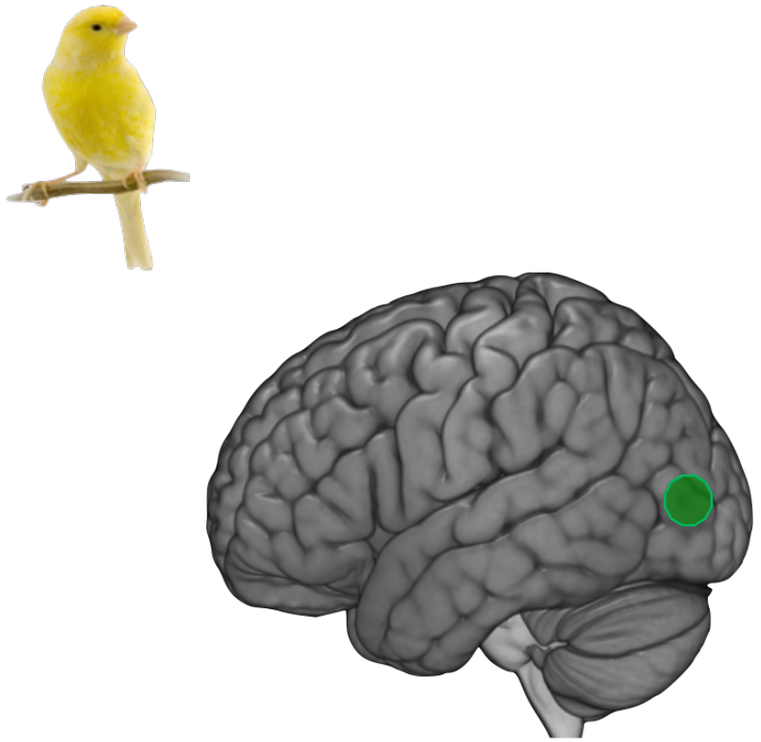


- Not only distinguish (MVPA) but look at the similarity between brain and model space

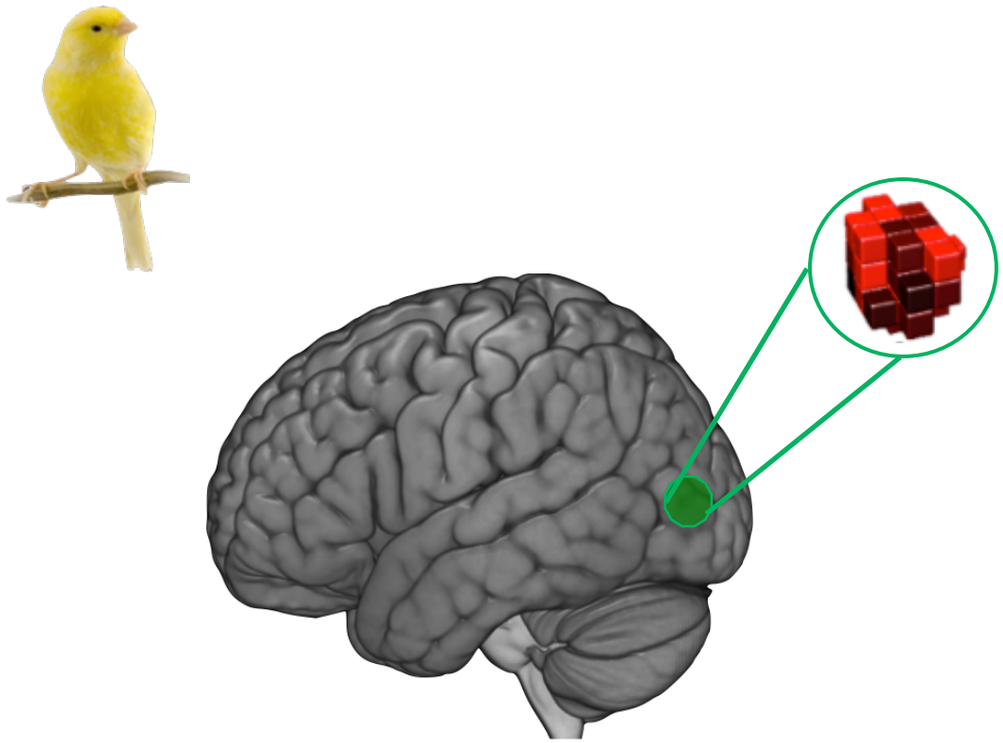
- Not only distinguish (MVPA) but look at the similarity between brain and model space



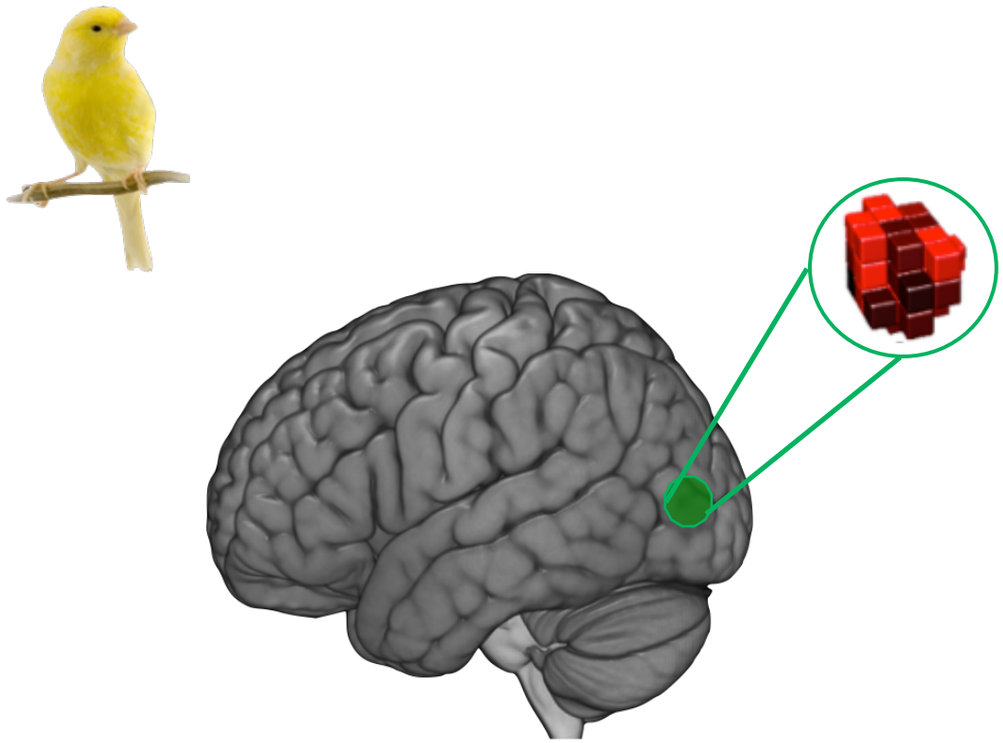
- Not only distinguish (MVPA) but look at the similarity between brain and model space



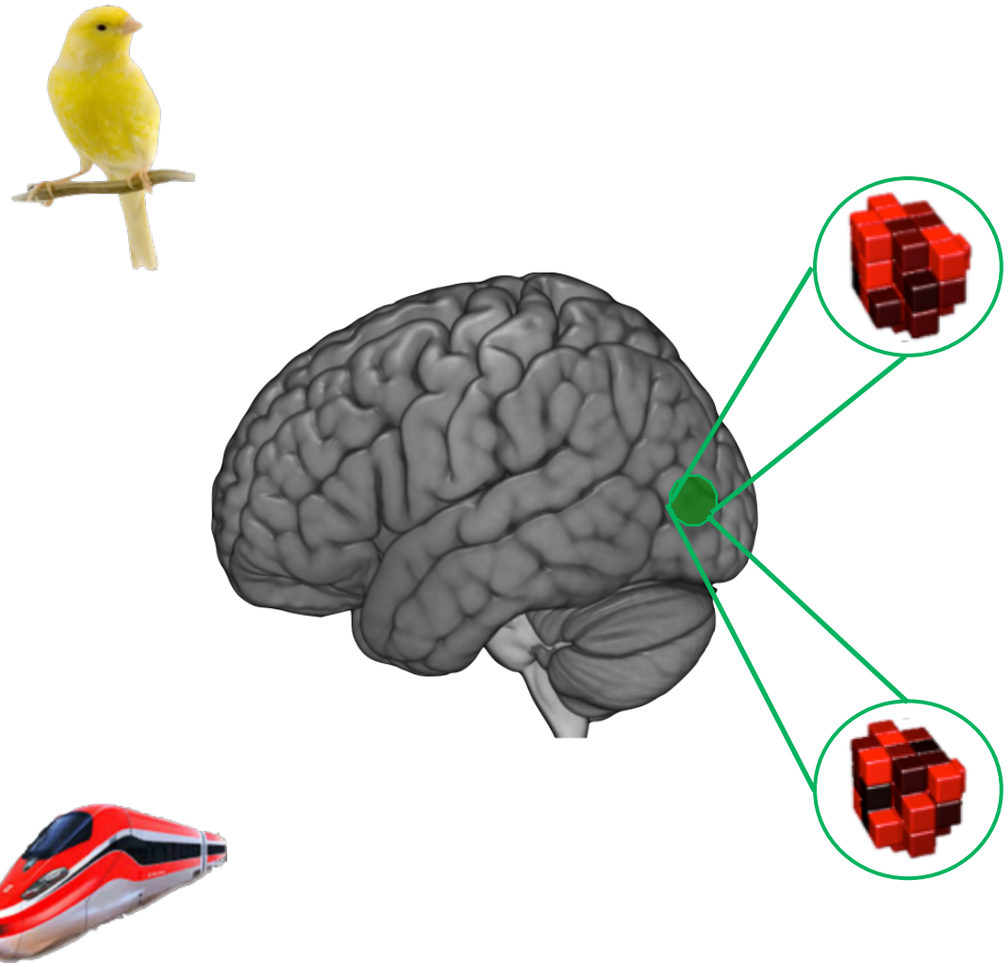
- Not only distinguish (MVPA) but look at the similarity between brain and model space



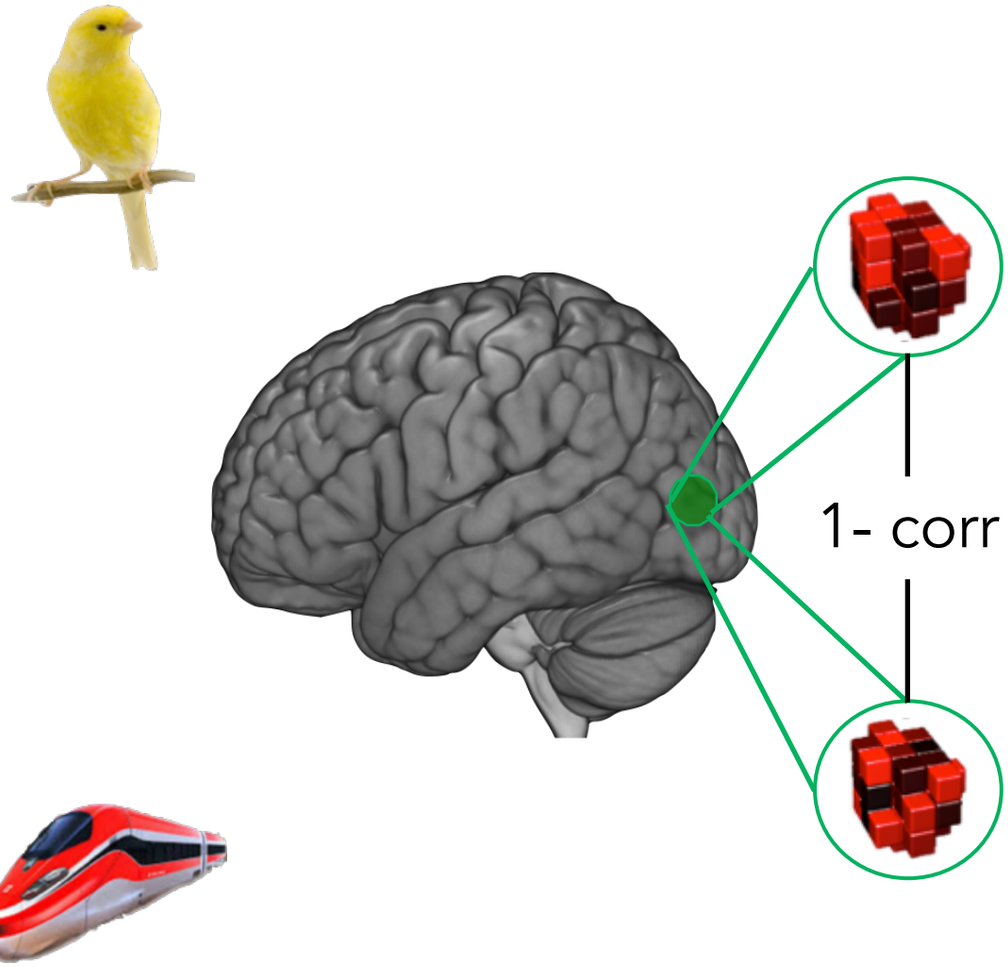
- Not only distinguish (MVPA) but look at the similarity between brain and model space



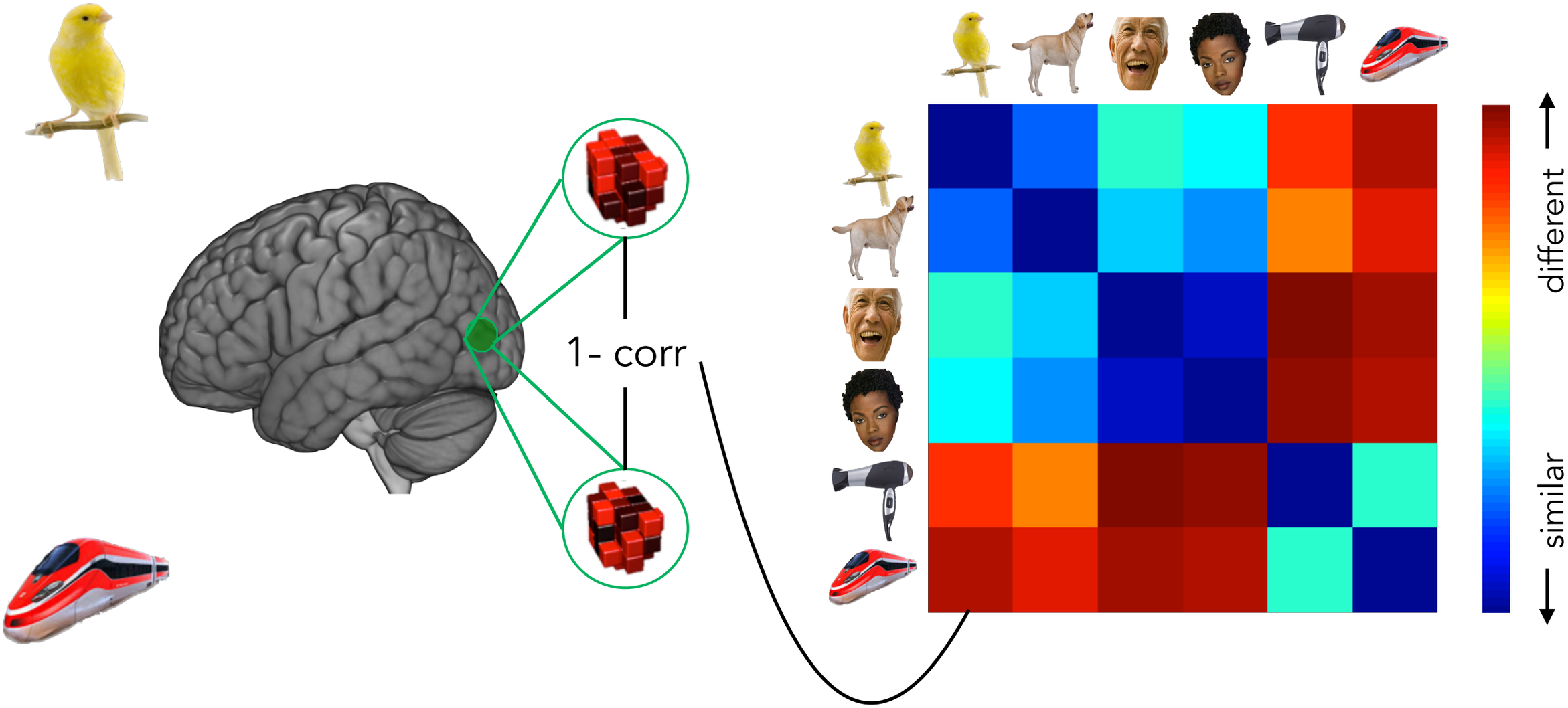
- Not only distinguish (MVPA) but look at the similarity between brain and model space



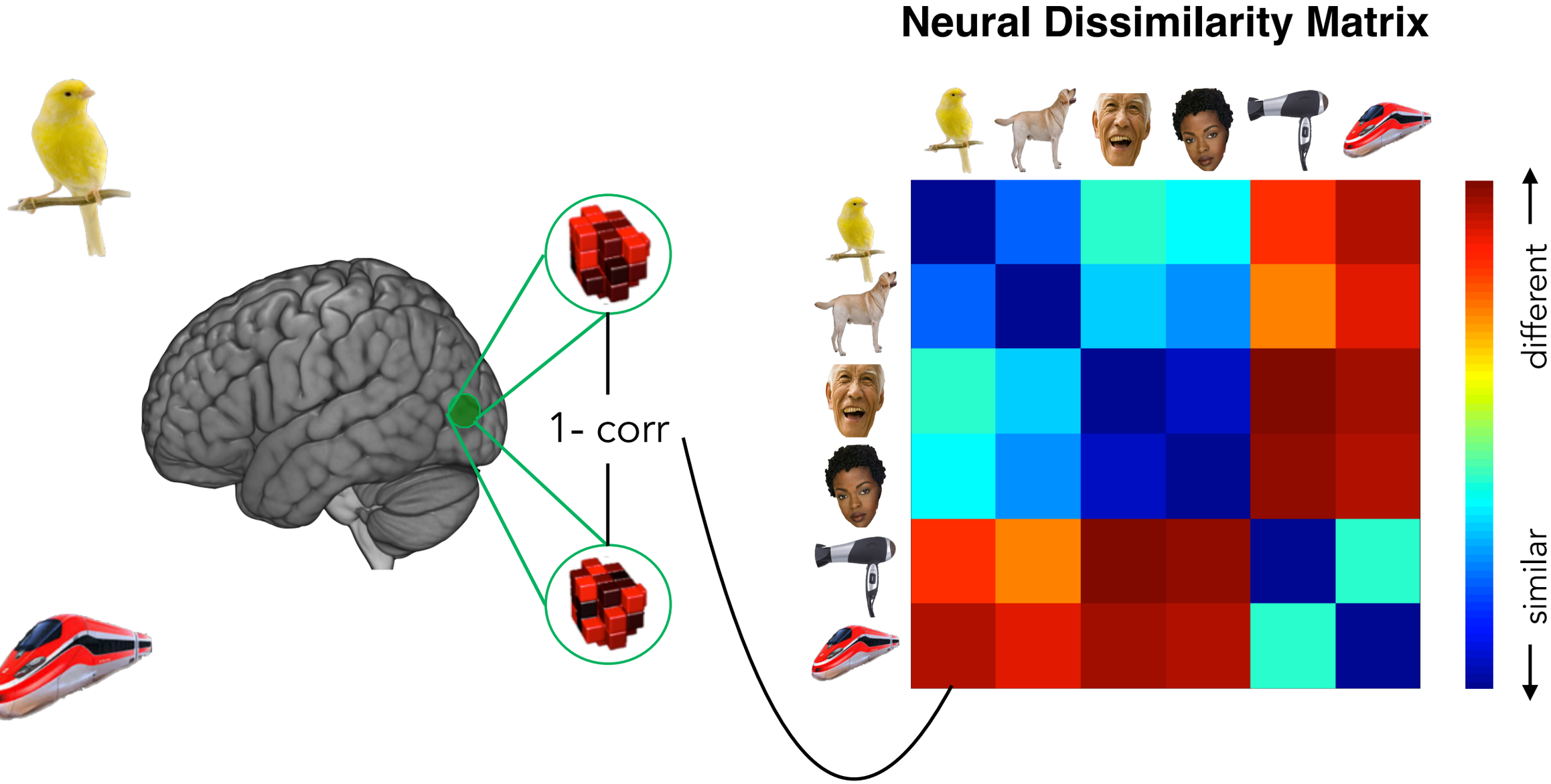
- Not only distinguish (MVPA) but look at the similarity between brain and model space



- Not only distinguish (MVPA) but look at the similarity between brain and model space



- Not only distinguish (MVPA) but look at the similarity between brain and model space



- Not only distinguish (MVPA) but look at the similarity between brain and model space