Laminar profiles of attentional and cross-modal influences in sensory cortices

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#BrainInDepth2018

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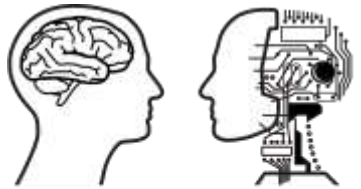

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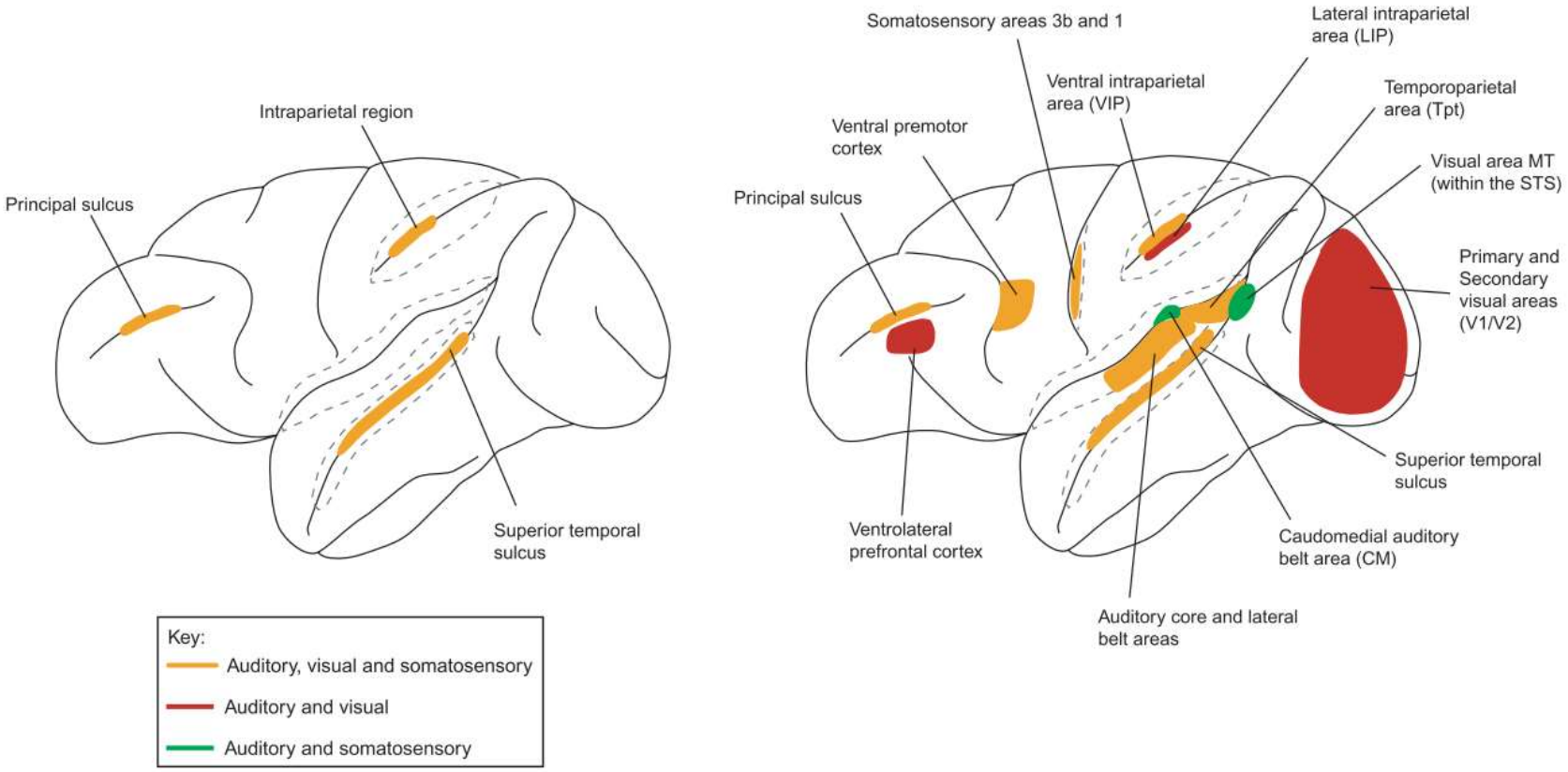
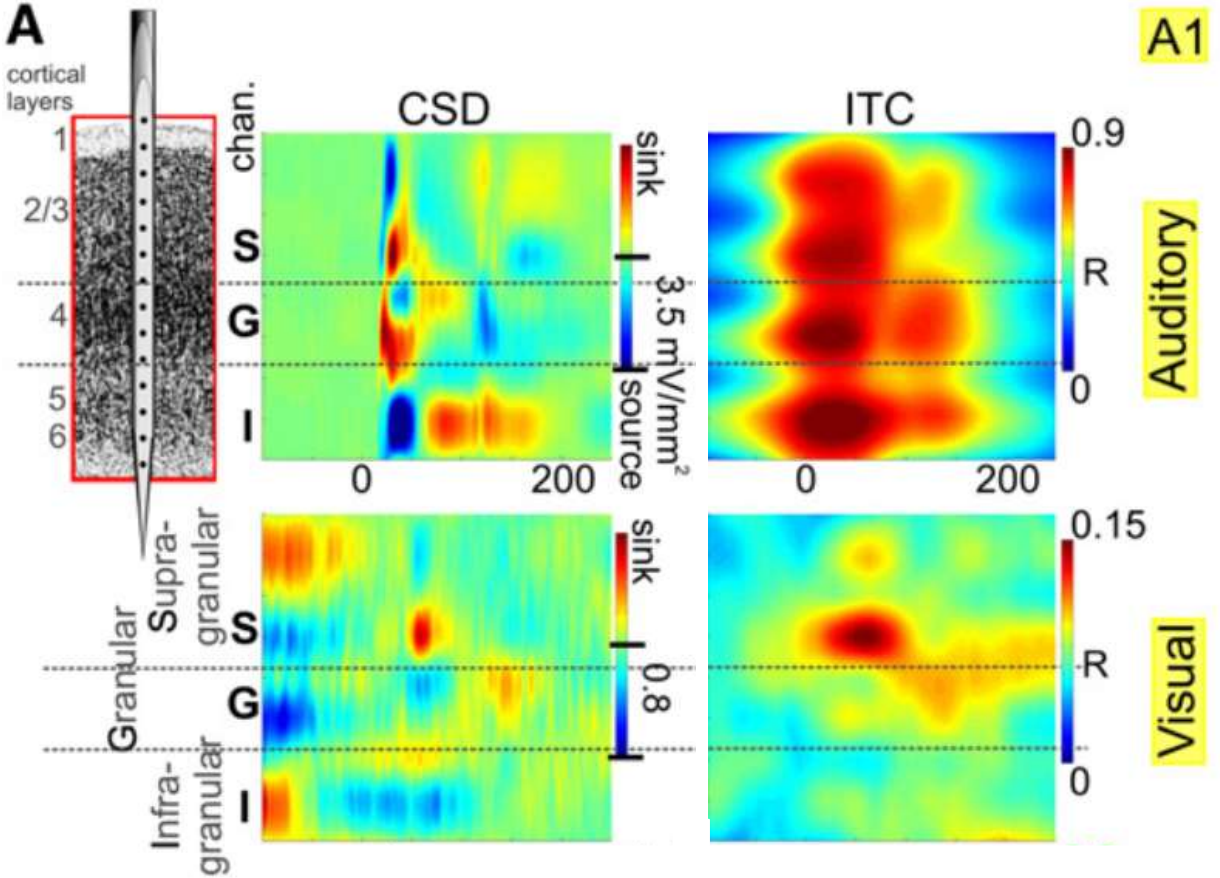
Crossmodal effects in SC



Ghazanfar & Schroeder, *TICS* (2006)

Crossmodal effects in SC

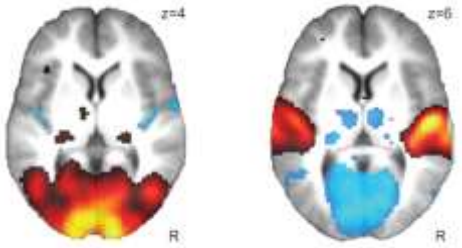
Laminar electrophysiology: CSD and phase resetting



Lakatos et al., *Neuron* (2009)

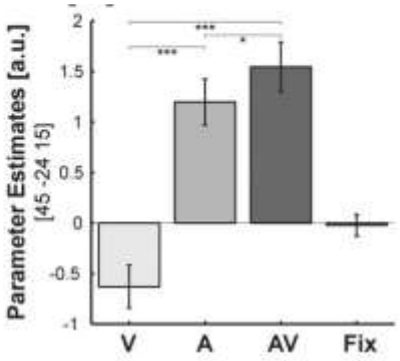
Crossmodal effects in SC

Uni-sensory
crossmodal deactivations



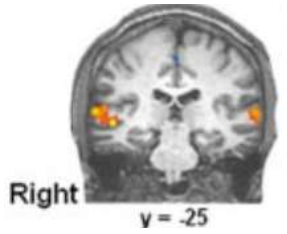
Leitao et al.,
Cerebral Cortex (2012)

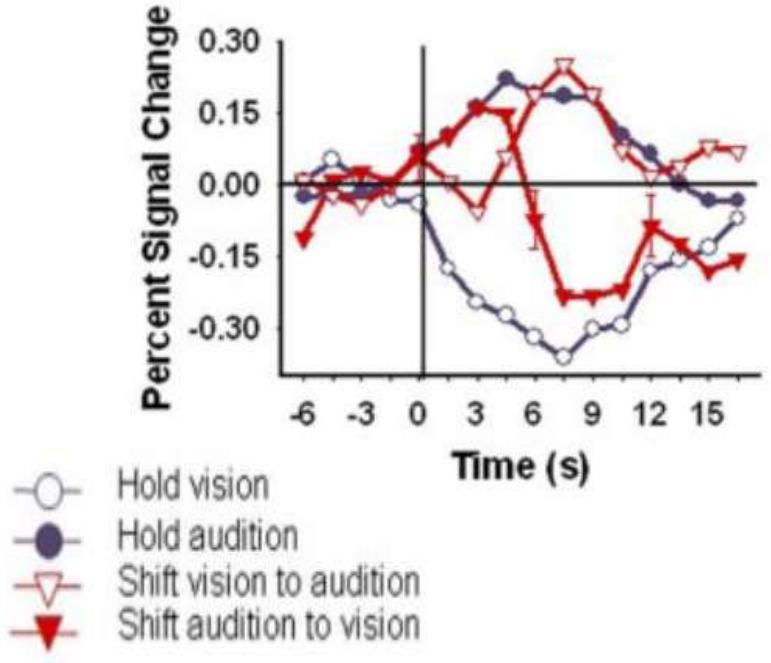
Multisensory
crossmodal enhancement



Werner & Noppeney,
J Neurosci (2010)

Attention





Shomstein & Yantis,
J Neurosci (2004)

Aim

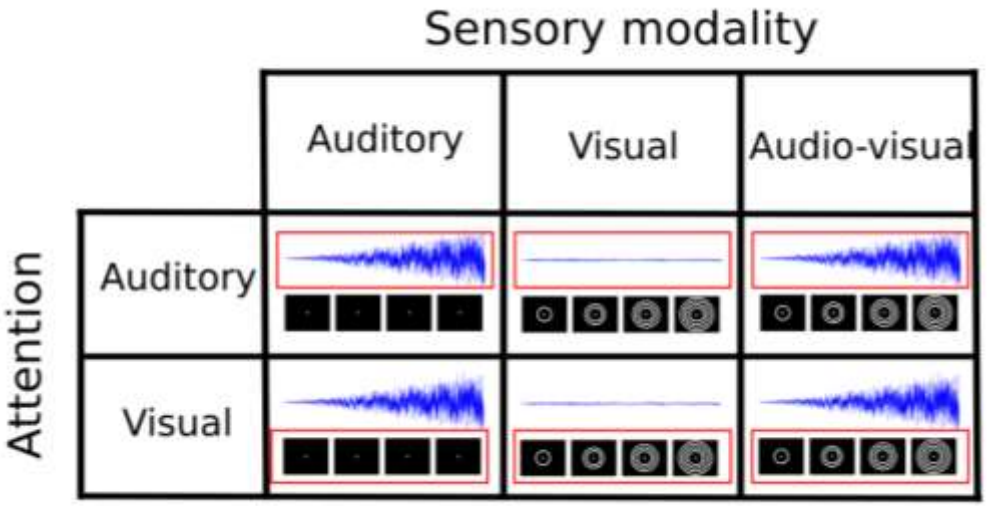
- Crossmodal deactivation and modulation
- Attentional modulation

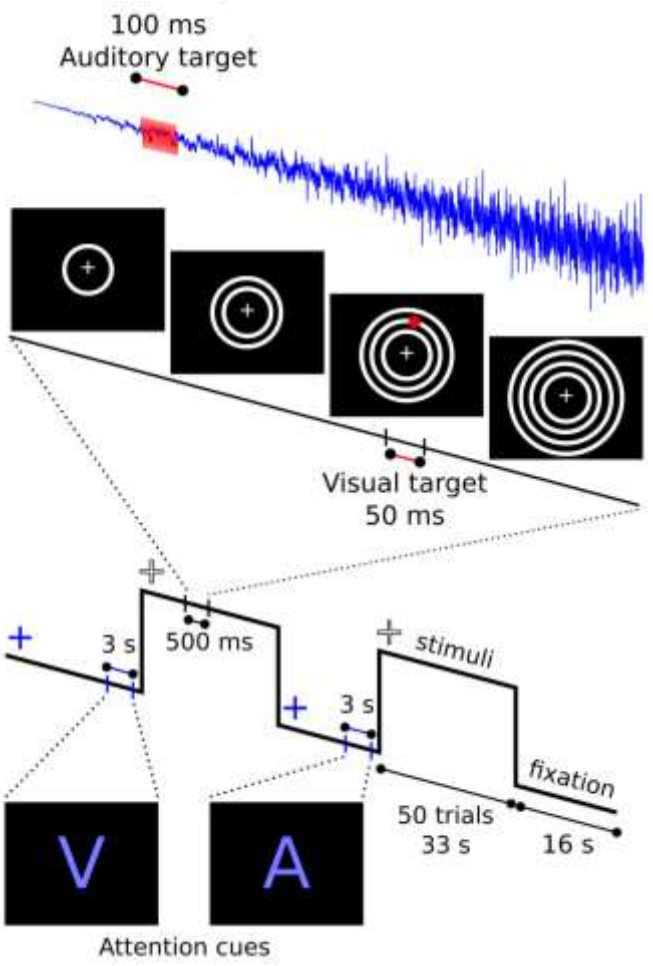
Do they have different laminar BOLD profiles?

Distinct laminar profiles could imply differing neural mechanisms.

Methods - Design

- **2 X 3 Factorial design**
- **Modality specific attention modulation**
- **11 subjects**



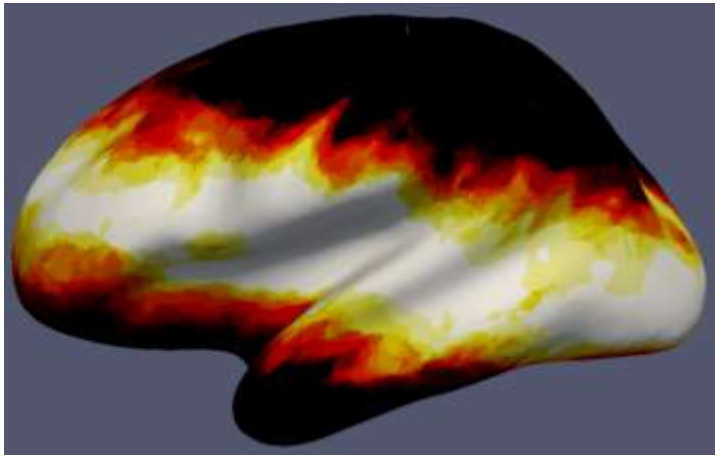


Methods - MRI

Anatomical: MP2RAGE - $(0.7\ mm)^3$

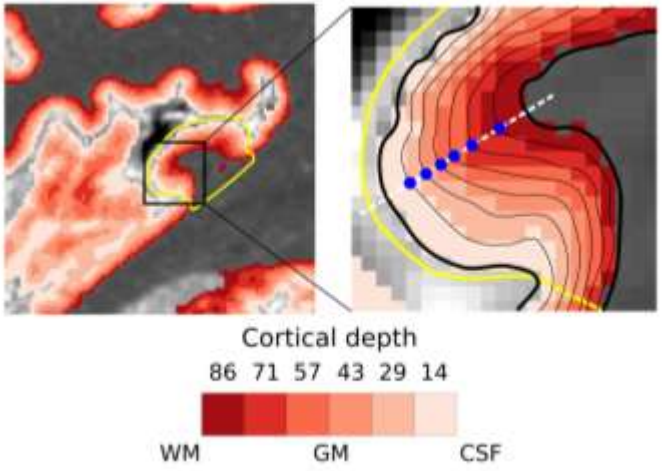
Functional: GE – EPI $(.75\ mm)^3$

- axial coverage of 3.6 cm
- TR/TE: 3000/25 ms
- GRAPPA/iPAT=4
- partial Fourrier: 6/8



Layer definitions:

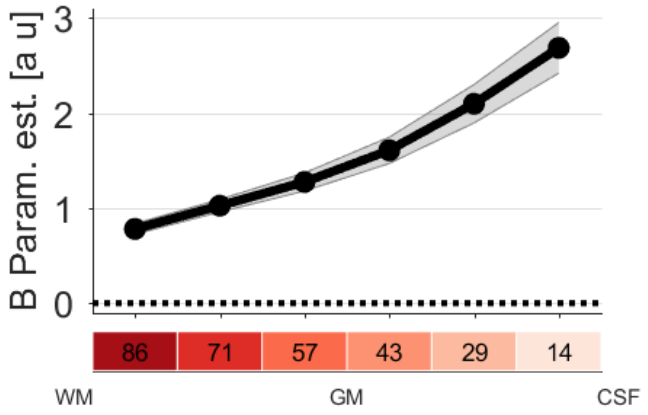
- CBS tools
- equivolume
- 6 intra-cortical surfaces

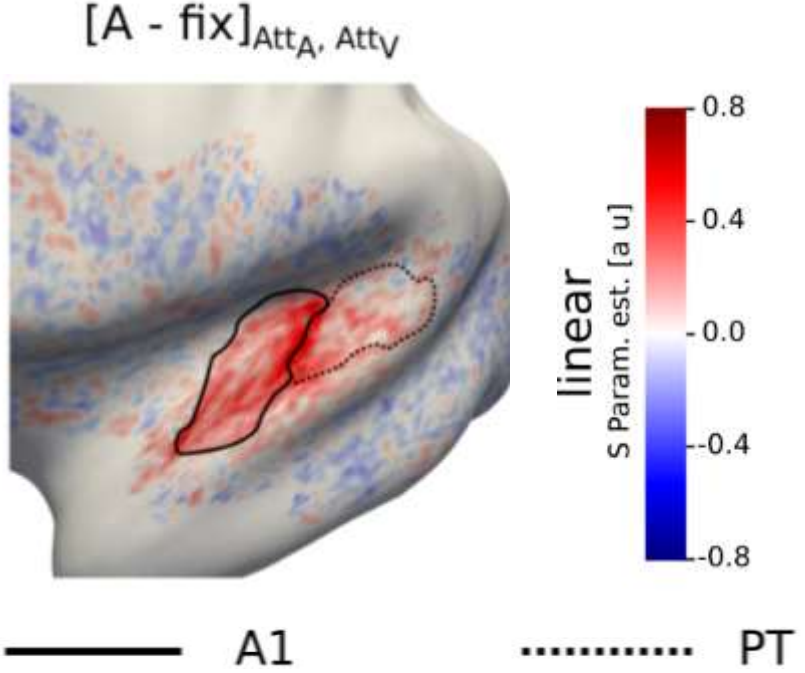


Methods – Laminar GLM

Characterise shape of :

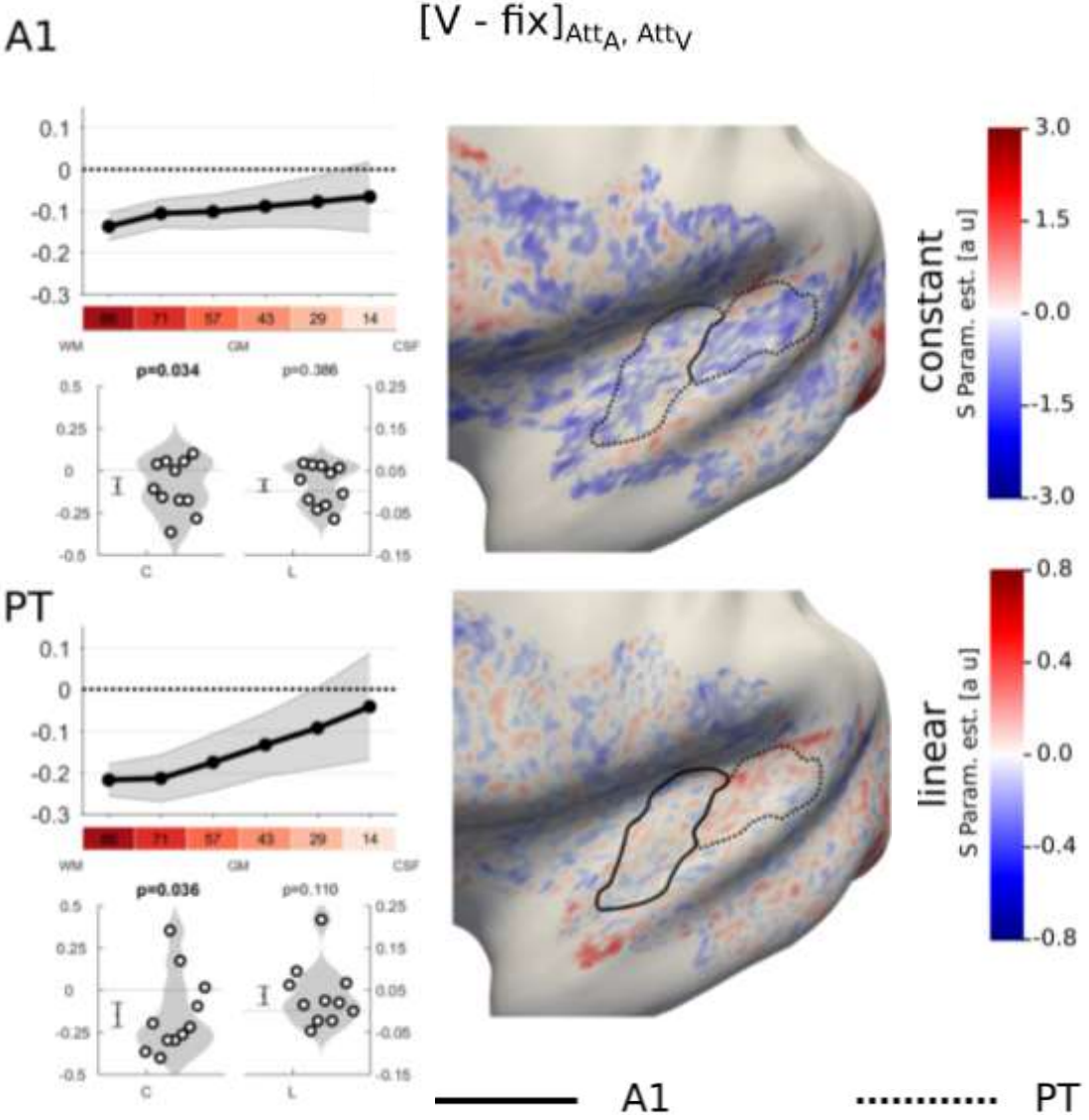
- BOLD profile,
- decoding accuracy profile,





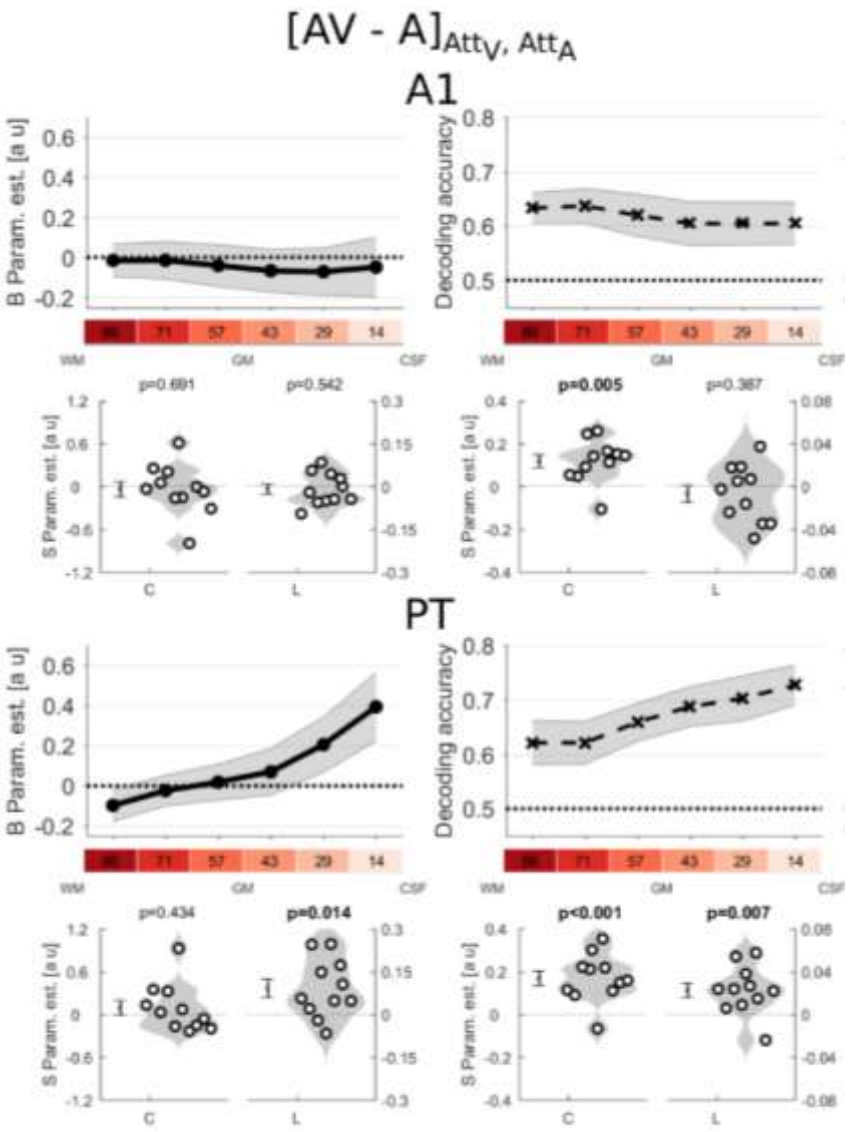
with a constant and linear term.

Auditory cortices – Deactivations



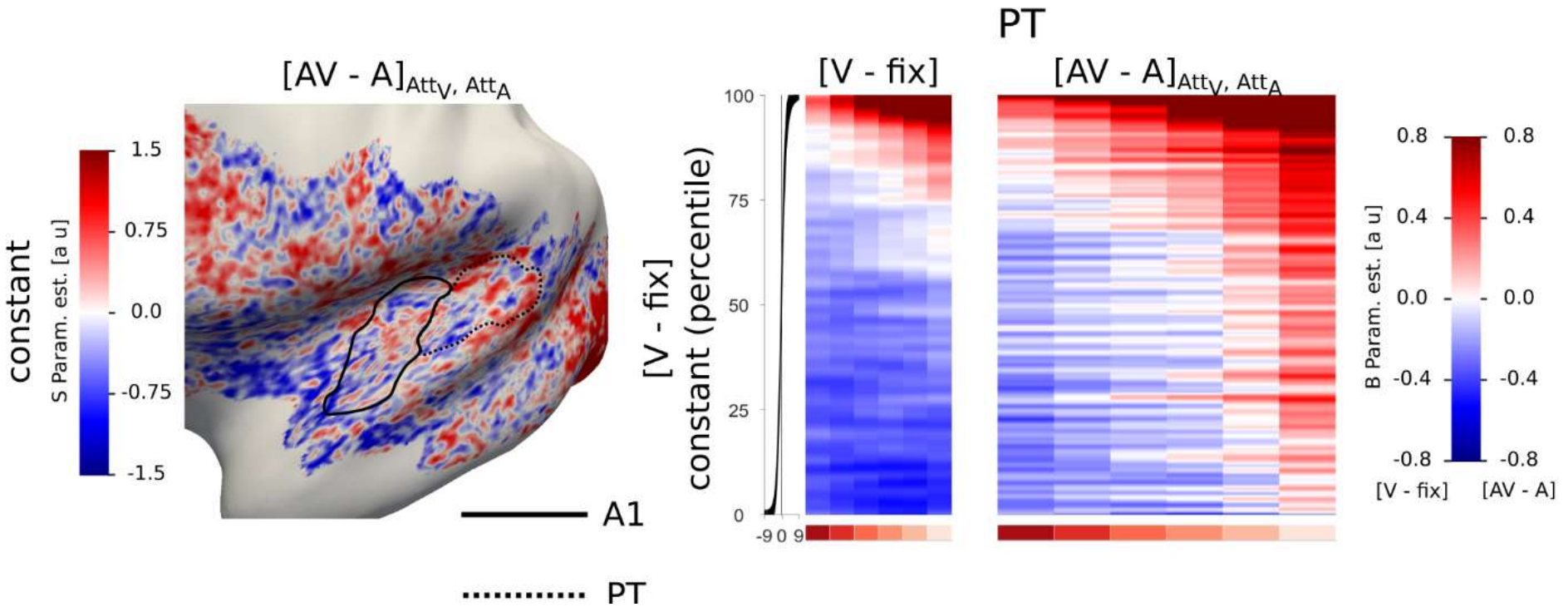
- Constant profile
- Max magnitude in deep layers
- Patchy organization

Auditory cortices – Crossmodal



- PT: maximum audio-visual enhancement at surface
- MVPA: Pattern change

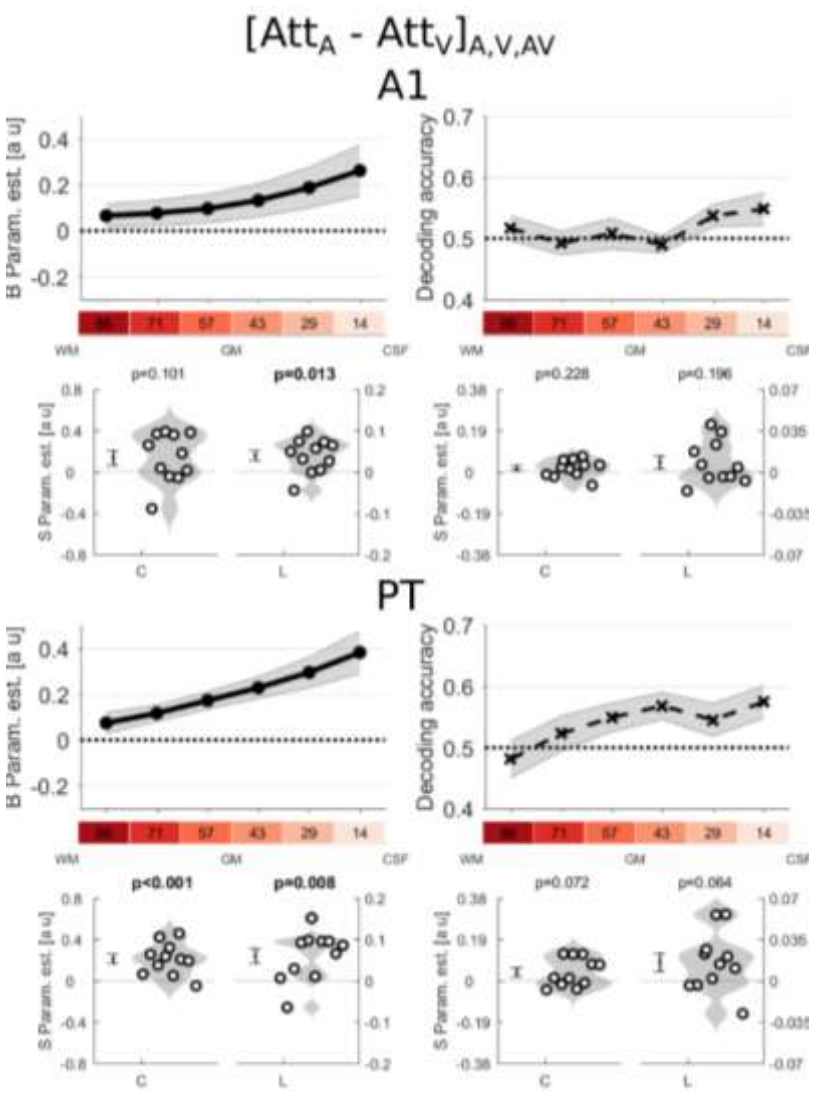
Auditory cortices – Crossmodal



- The profile of the crossmodal modulation is predicted by that of the visual stimulus.

- The topography of the multisensory amplification induced by visual stimuli is similar to the topography of unisensory deactivations.

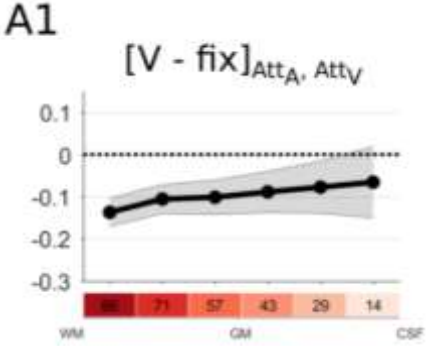
Auditory cortices – Attention



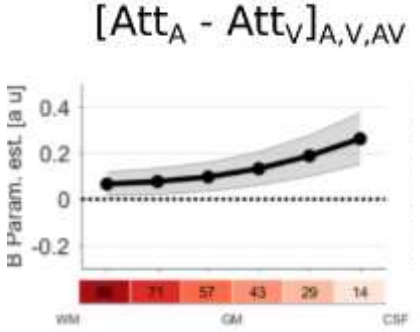
- Maximum BOLD at the surface
- MVPA: no pattern change

Summary -- I

- Visual induced deactivations and modulations:
  - constant or greatest in deeper laminae
  - similar topography

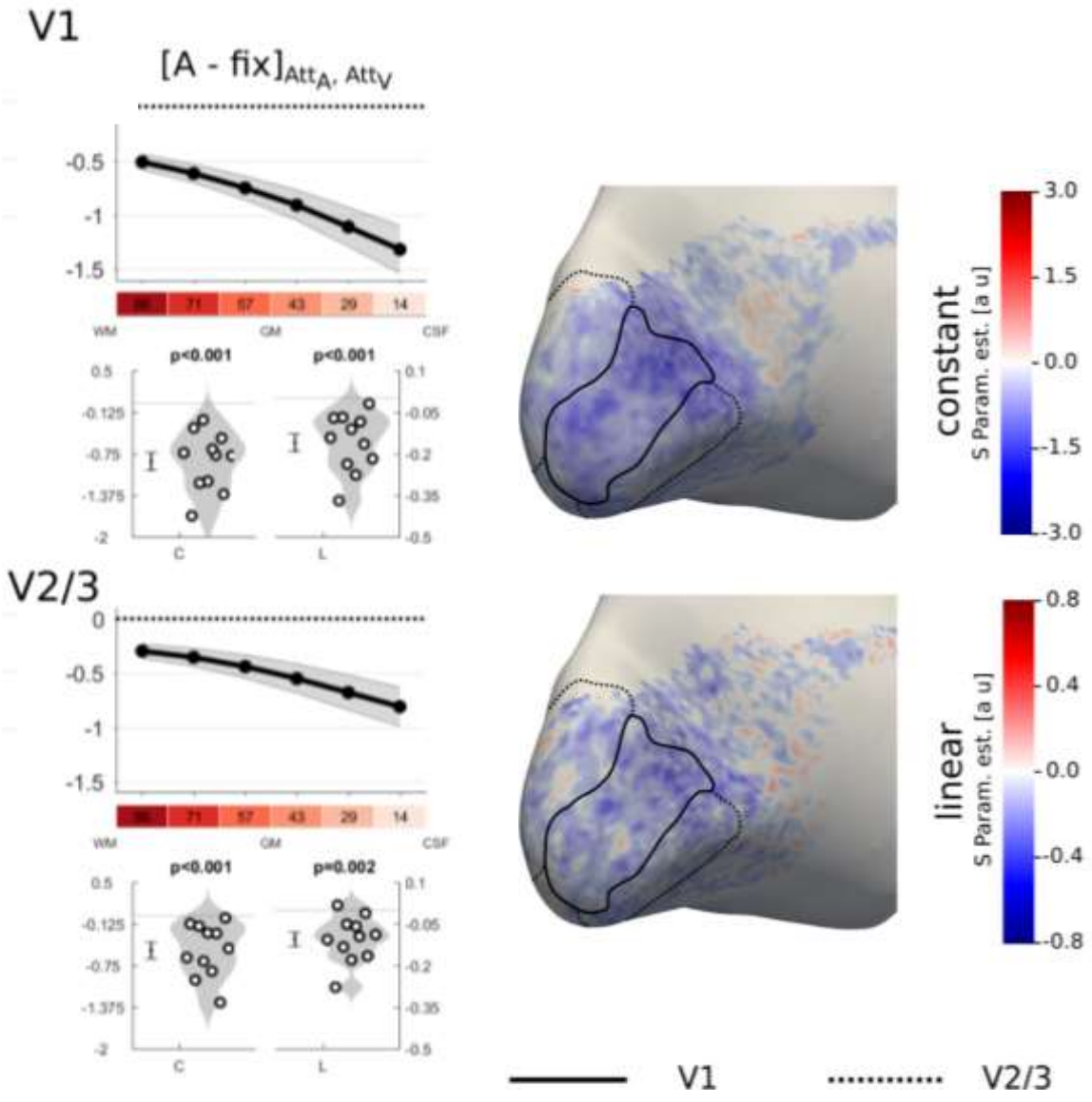


- Attention modulation:
  - largest at cortical surface



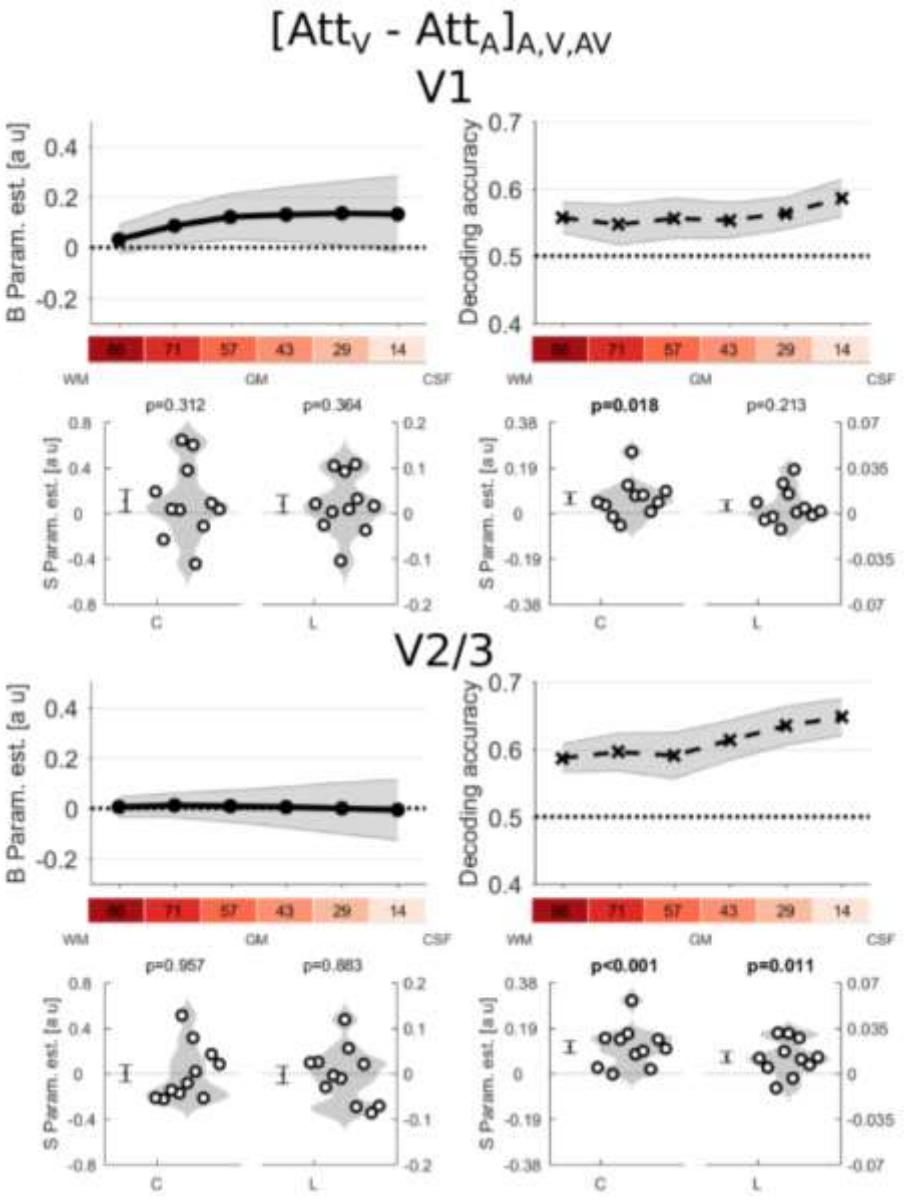
Distinct laminar profiles and topography suggest partly distinct mechanisms for attention and crossmodal influences.

Visual cortices – Deactivations



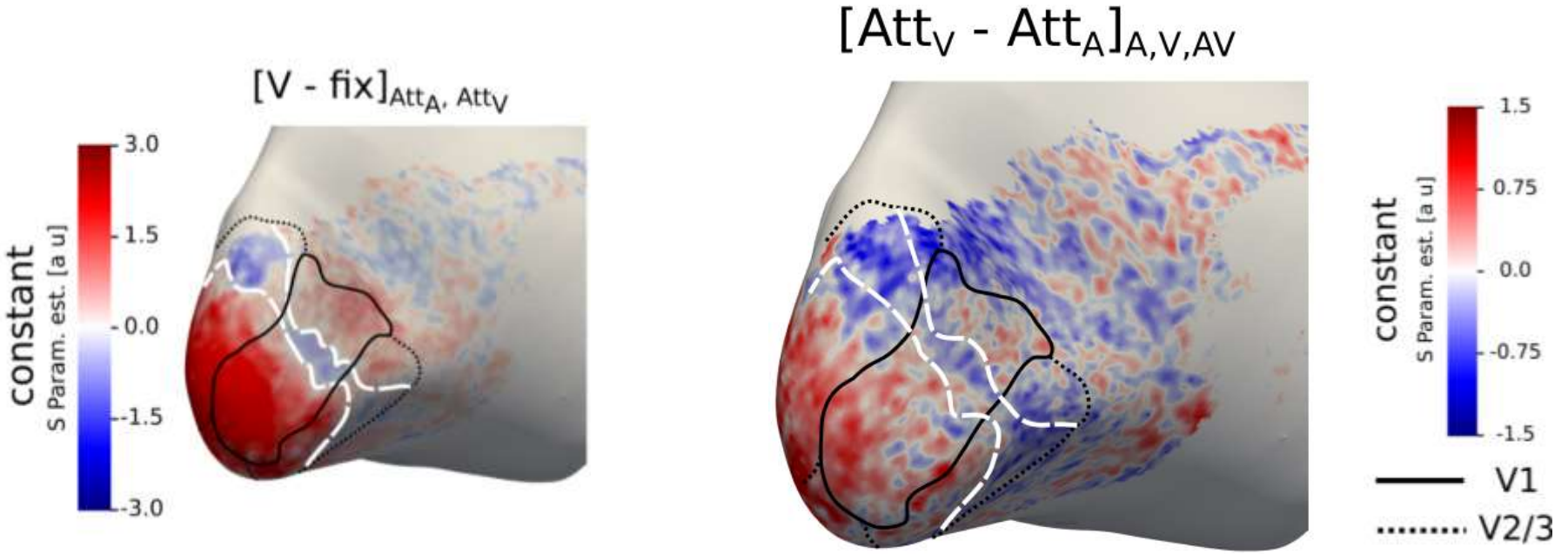
- Maximum at the surface
- Homogeneous topography

Visual cortices – Attention

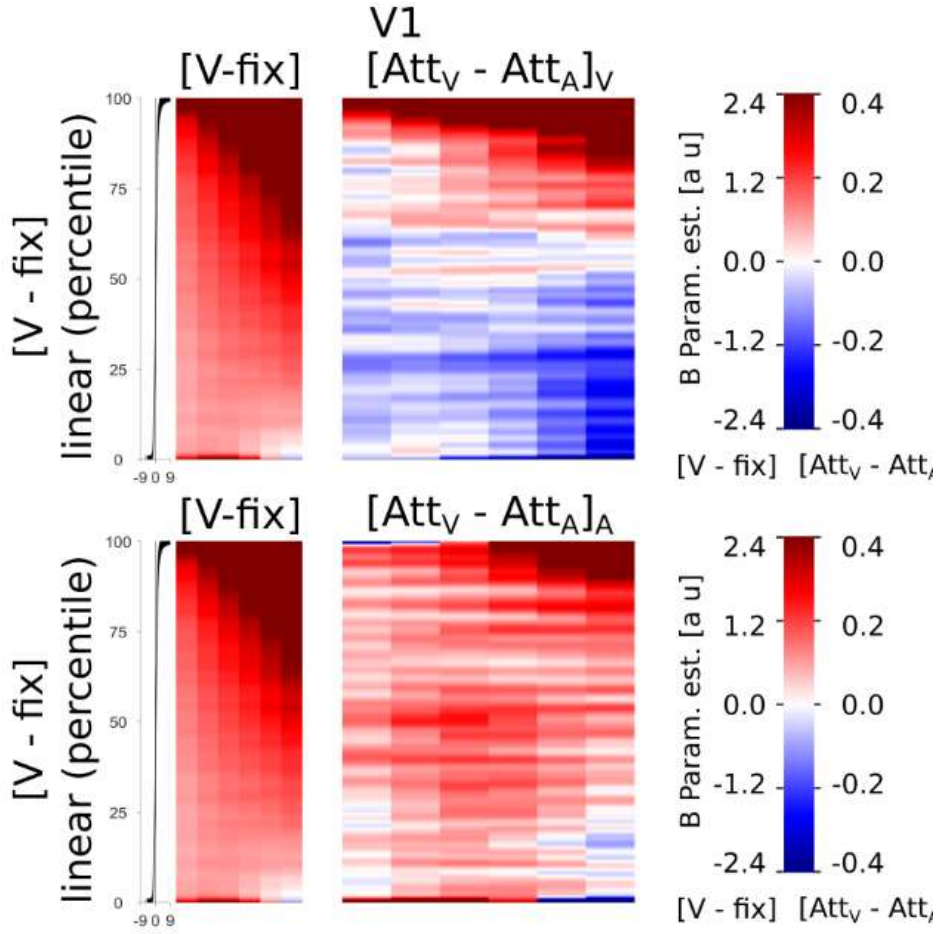


- No effects on BOLD profile
- Change in activation pattern

Visual cortices – Attention



Visual cortices – Attention

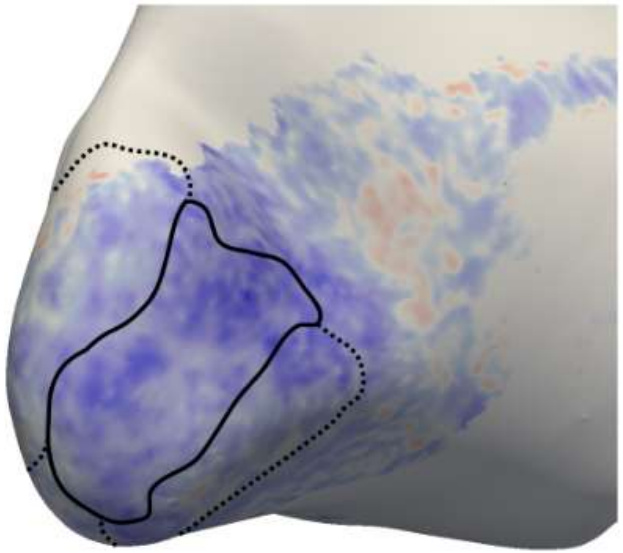


The way attention enhances the activations of a stimulus could be predicted by the profile response to visual stimuli alone.

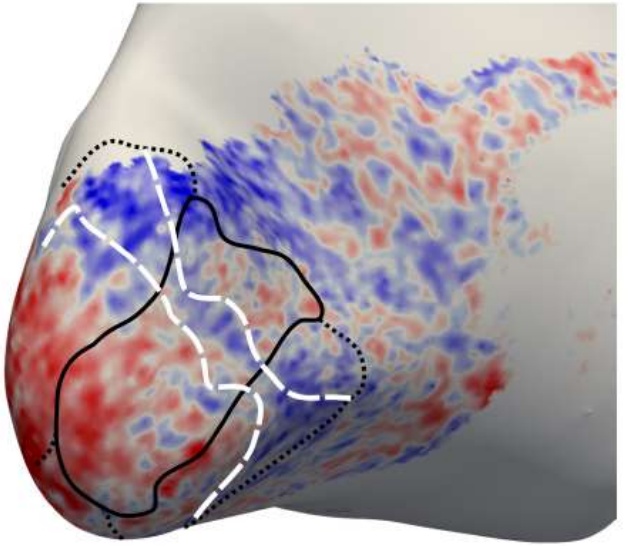
Summary -- II

Auditory induced deactivations and attentional modulations emerge with different laminar profile topographies.

$[A - fix]_{Att_A,\ Att_V}$



$[Att_V - Att_A]_{A,V,AV}$



Summary -- II

How is sensory processing regulated by inter-sensory competition and attentional control ?

Auditory cortices

Different profiles

Visual cortices

Different topographies

Thank you for your attention.

Supervision

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