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Moving toward versus away from another: How motion direction changes the representation of bodies and actions in visual cortex

Emmanuelle Bellot, Etienne Abassi, Liuba Papeo

► **To cite this version:**

Emmanuelle Bellot, Etienne Abassi, Liuba Papeo. Moving toward versus away from another: How motion direction changes the representation of bodies and actions in visual cortex. FENS (Federation of European Neuroscience Societies) Congress, Jul 2020, Glasgow, France. hal-02937754

HAL Id: hal-02937754

<https://hal.science/hal-02937754v1>

Submitted on 14 Sep 2020

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Emmanuelle Bellet^{1,2}, Etienne Abassi^{1,2} & Liuba Papeo^{1,2}

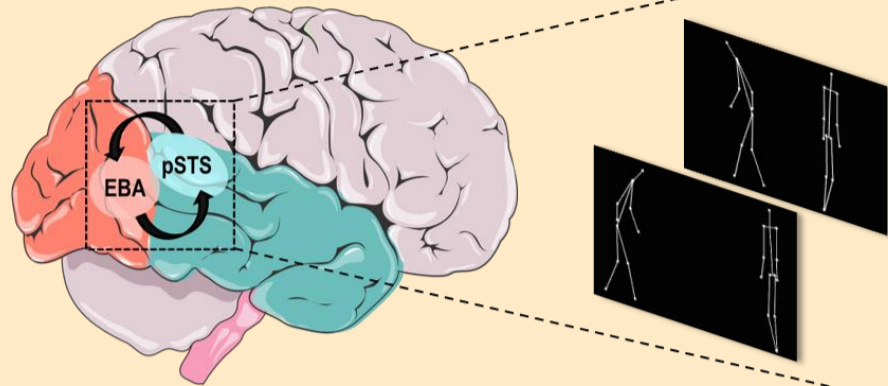
¹ Institut des Sciences Cognitives Marc Jeannerod, UMR5229, CNRS, Bron, France

² Université Claude Bernard Lyon 1, Villeurbanne, France

emmlle.bellet@gmail.com

BACKGROUND & OBJECTIVES

How does the brain build the representation of events? The presence of certain visuo-spatial relations in a scene may contribute to channel object, or scene, perception into event representation.



Here we assessed:

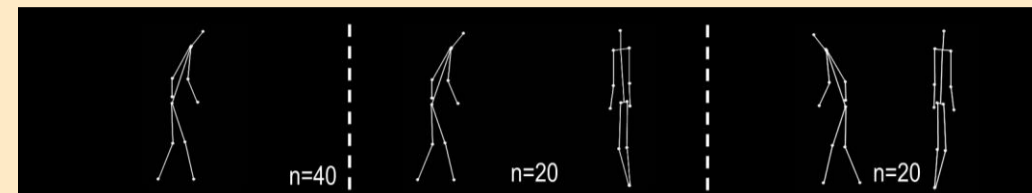
- How brain areas, key for the visual perception of bodies^{1,2} (**Extrastriate Body Area, EBA**) and body motion³⁻⁶ (**posterior Superior Temporal Sulcus, pSTS**) encode dynamic scenes featuring multiple bodies acting and moving toward one another as if interacting (**facing dyad**) or acting and moving away for one another (**non-facing dyads**).
- Whether the presence of visuo-spatial cues of interaction in multiple-body scenarios increases the coupling between the EBA and pSTS.

METHODOLOGY

SUBJECTS: 20 healthy right-handed participants (11 ♀, 25±4Yo) with normal vision.

STIMULI

Main experiment: 2-sec point-light movies⁷



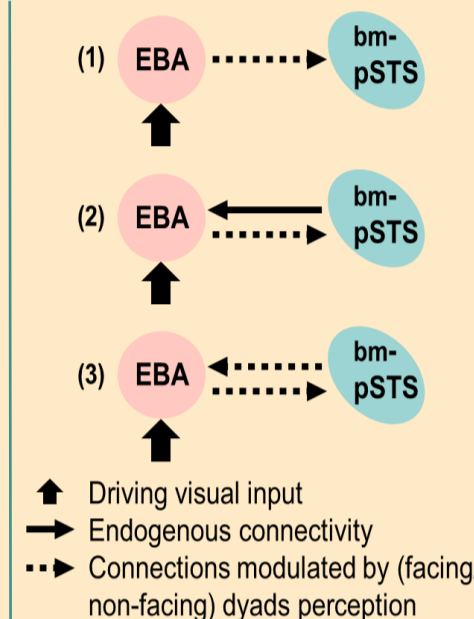
Functional localizer tasks:

- **biological motion pSTS (bm-pSTS):** [biological motion vs. scrambled motion] - **EBA:** [body vs. objects]
- **Control regions:** PPA (Parahippocampal Place Area): [places vs. objects] - **EVC** (Early Visual Cortex): probabilistic map of visual topography.

MRI PROTOCOL: 3T-fMRI, event-related design, 3 categories of stimuli: i) left- or right-oriented single bodies, ii) facing-bodies and iii) non-facing bodies.

ANALYSIS

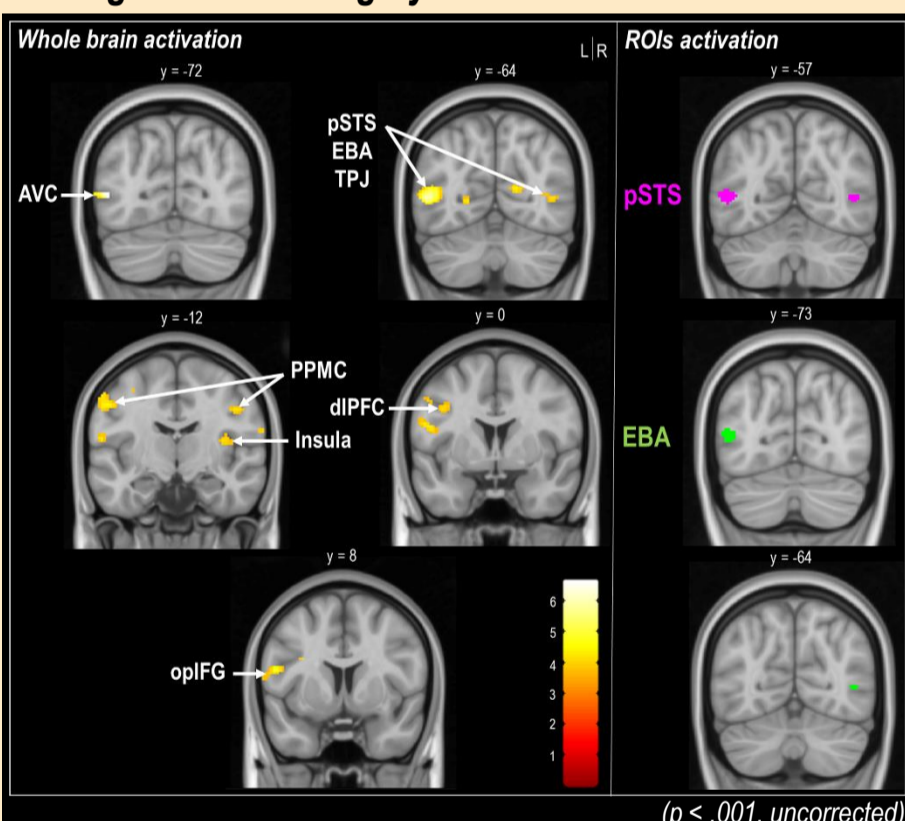
- **MRI:** Facing vs. Non-facing dyads activations (univariate analysis) - Multi-Voxels Pattern Analysis (MVPA)
- **Dynamic Causal Modelling analysis (DCM):**
 - > 2 hubs: EBA and bm-pSTS
 - > Driving visual input: single bodies
 - > Uni/bidirectional connections
 - > 2 model spaces : facing vs. non-facing
 - > 3 models compared & averaged



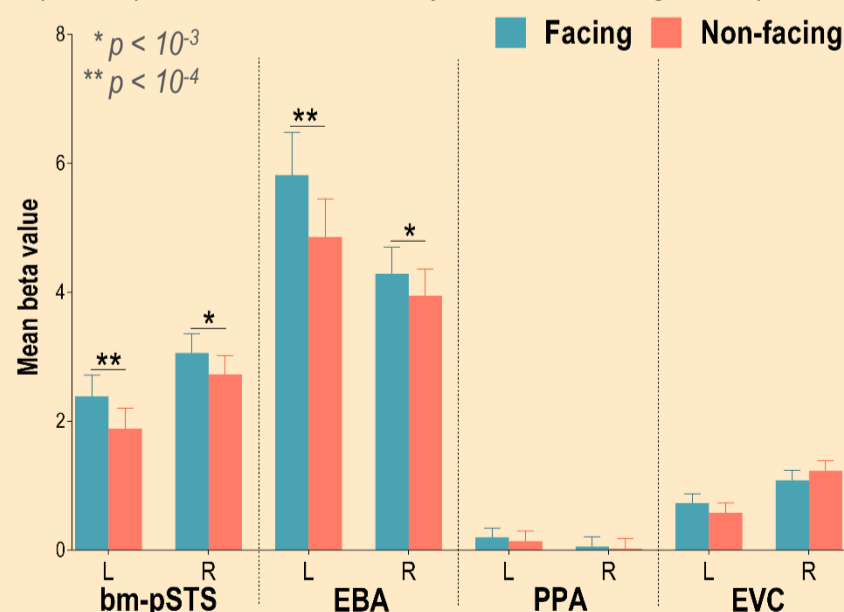
RESULTS

UNIVARIATE ANALYSES

Facing vs. Non-facing dyads



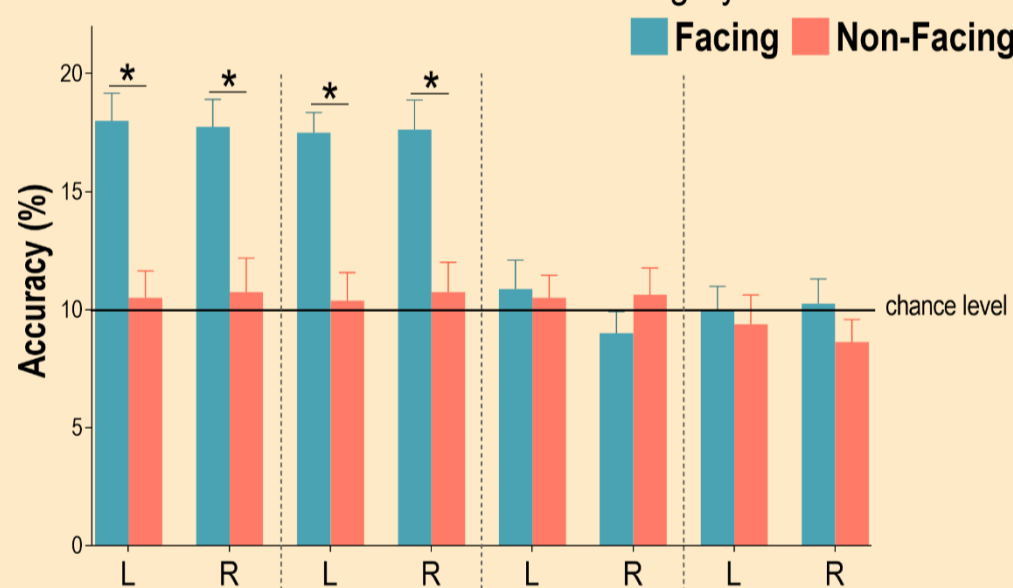
TPJ = Temporoparietal Junction, AVC = Associative Visual Cortex, PPMc = Premotor and Primary Motor Cortex, dlPFC = dorsolateral Prefrontal Cortex, opIFG = opercular part of the Inferior Frontal Gyrus. L/R = left and right hemispheres.



MULTIVARIATE ANALYSES

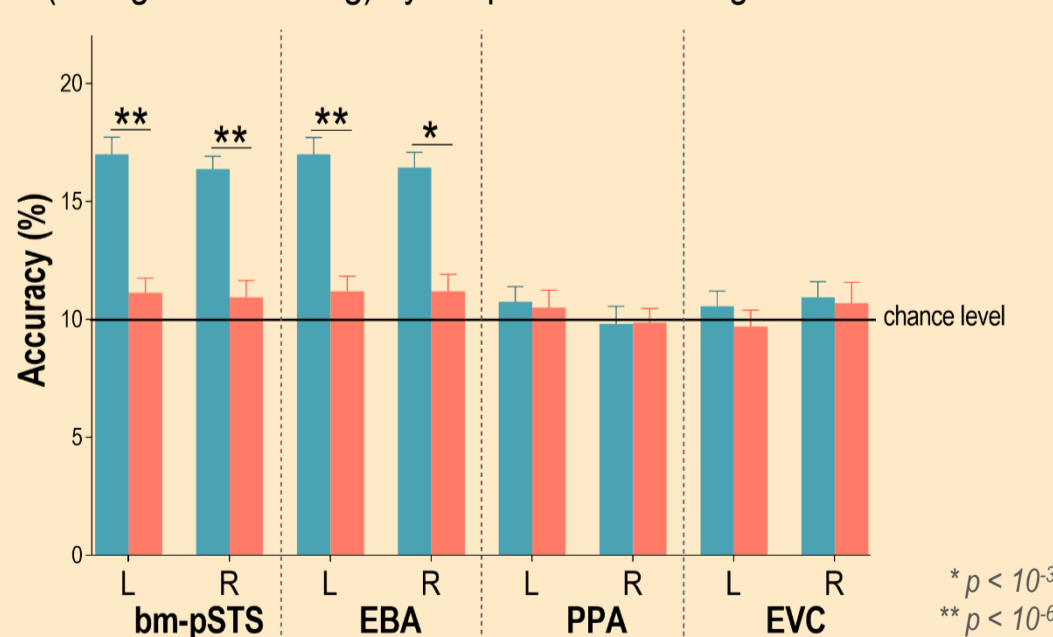
Representation of dyads

How well a neural pattern corresponding to a dyad could be discriminated from the others of the same category.



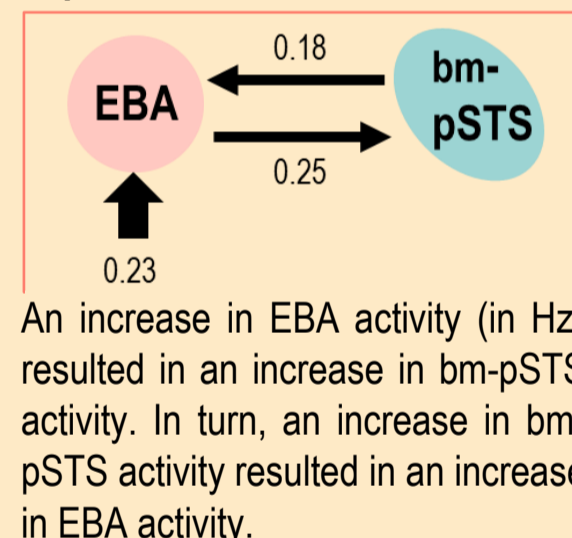
Representation of individuals in dyads

How well single bodies presented during training, could be discriminated in the (facing or non-facing) dyads presented during the test.

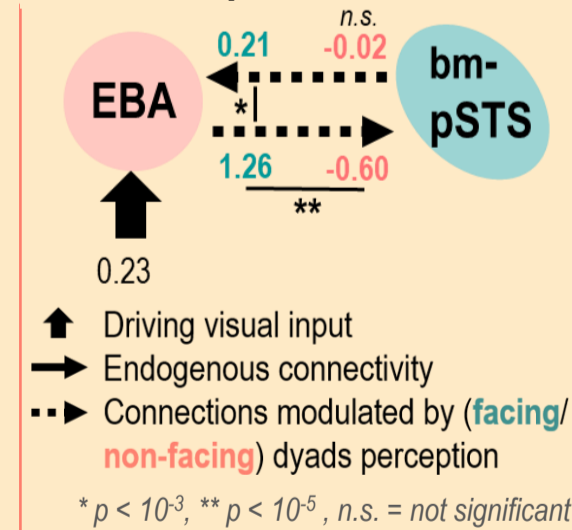


DCM ANALYSES

Modulation of the connectivity between the EBA and bm-pSTS by dyads perception



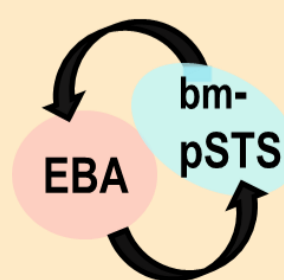
An increase in EBA activity (in Hz) resulted in an increase in bm-pSTS activity. In turn, an increase in bm-pSTS activity resulted in an increase in EBA activity.



Perception of facing/non-facing dyads increased/decreased the connection strength (in Hz) between EBA and bm-pSTS. Positive modulatory feedback from bm-pSTS to EBA only observed for facing dyads perception.

CONCLUSION

Seeing bodies facing and moving toward one another enriches the representation of individual body posture and movement (neural sharpening) and increases discrimination of the overall scene.



Increased coupling between EBA and bm-pSTS in facing dyads condition demonstrates that visuo-spatial cues of interaction not only affect the perceptual representation of body and body motion in ROIs but also streamline the process from body perception to action representation promoting functional integration. Such network could give rise to the perceptual rudiment of the to-be representation of a social-event, based on the physical structure of the input, before inferential processes kick-in.