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Multivariate analysis of affective body perception using postural and kinematic features of movement

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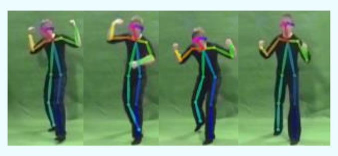
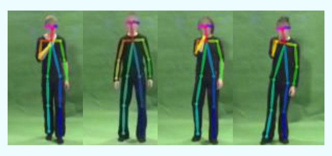
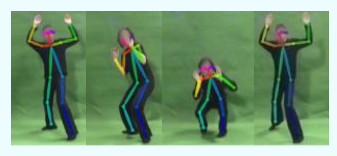
Introduction

When we observe someone performing an affective body movement, our brains transform this information into an understanding of the intent and the emotion expressed **[1, 2]**. However, the mechanisms underlying this ability are still largely unclear. This study aims at elucidating which low-level movement properties (i.e. kinematic and postural features) are important for the perception and classification of emotion from body movements and how these properties are represented in the different brain regions involved in body perception.

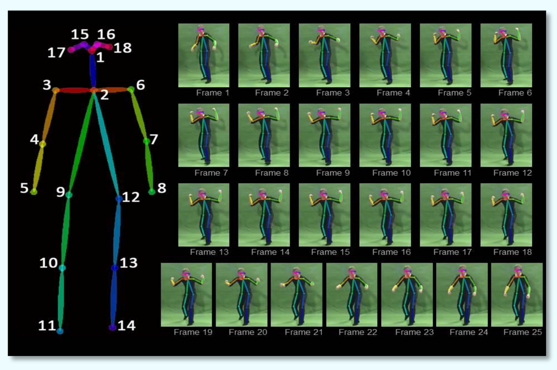
Methods & Results

Stimuli:
56 1-second video clips of whole-body movements (4 categories)

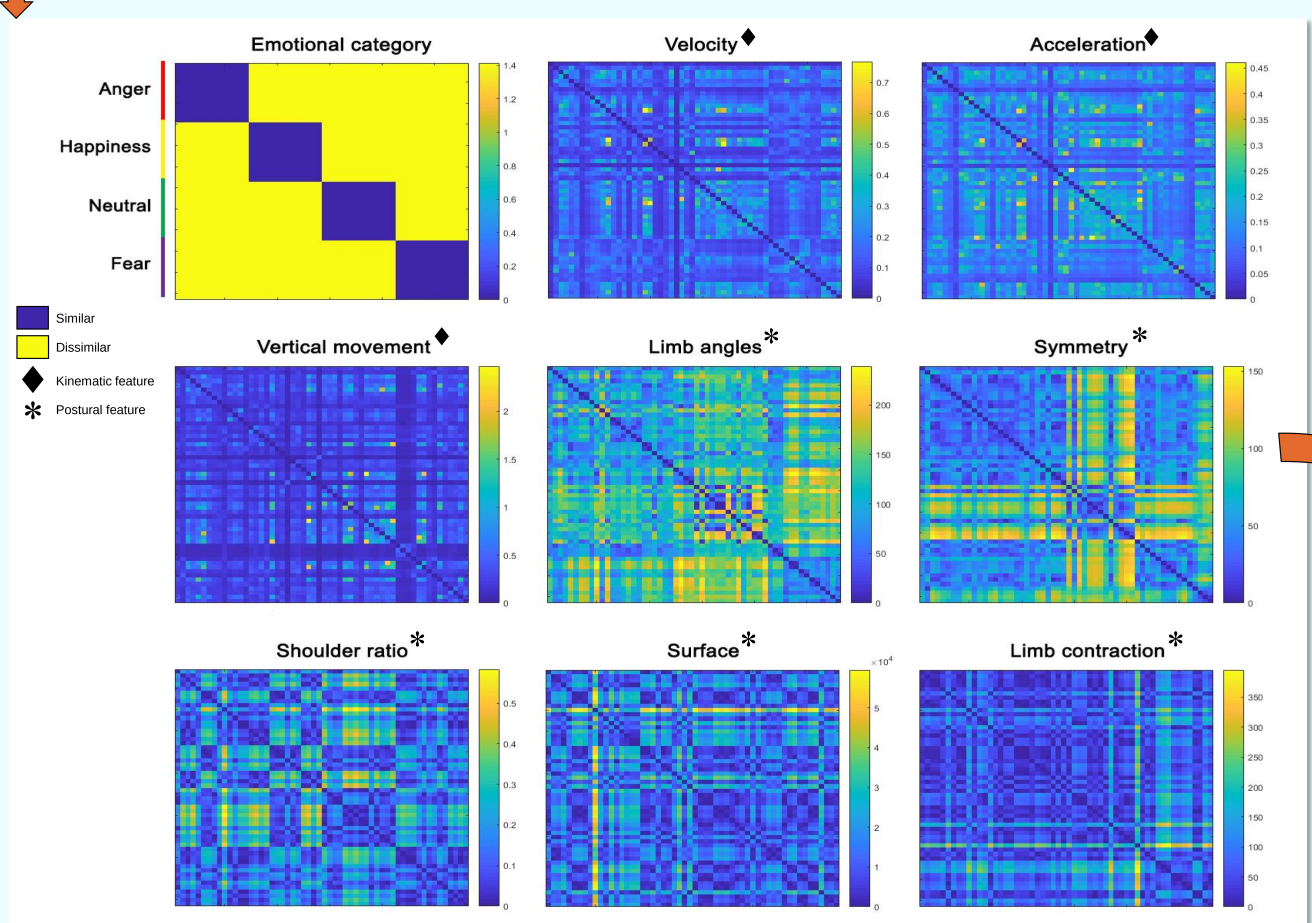

ANGER

HAPPINESS

NEUTRAL

FEAR

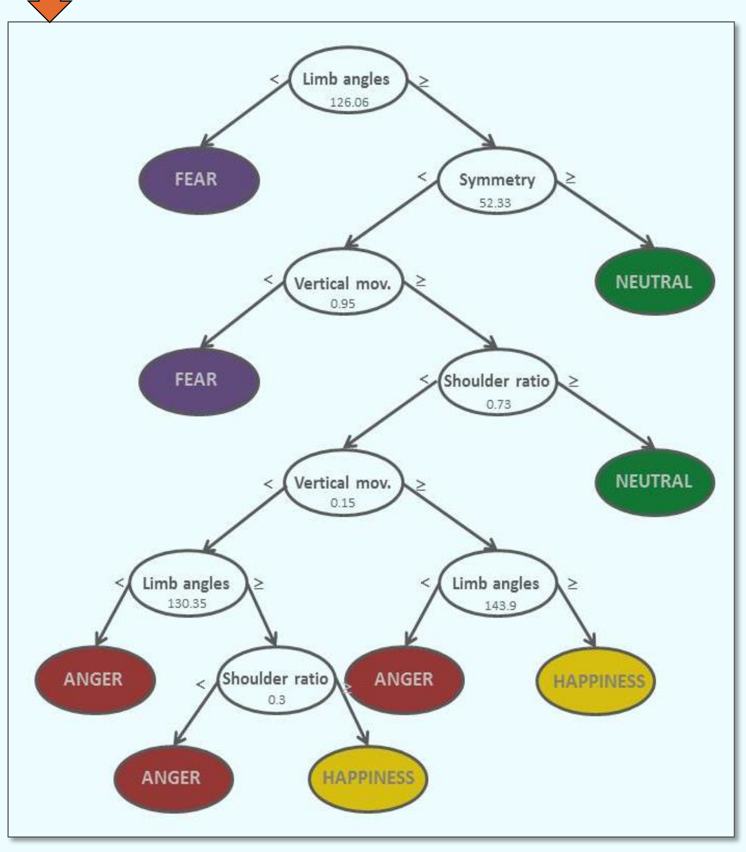
Each actor's joint positions were estimated for each frame in every video using OpenPose **[3]**. Subsequently, quantitative body features were computed from the joint positions, and their time information was averaged.



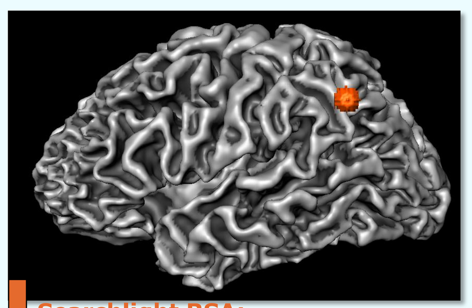
Representation similarity analysis (RSA): pairwise-dissimilarities across videos (Euclidean distance)



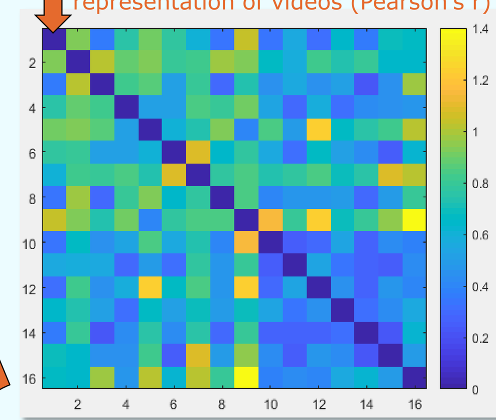
Decision tree: classification of emotion categories with the postural and kinematic features as predictors.



- Postural rather than kinematic features displayed a clear differentiation between emotional categories.
- Classifying emotion with a decision tree revealed that limb angles, symmetry and vertical displacement are the most important features for emotional classification (accuracy = 61%, chance level = 25%).
- When keeping the time information of the features for the classification of emotion, limb angles, shoulder ratio and limb contraction showed to be the most relevant ones (accuracy = 84%).

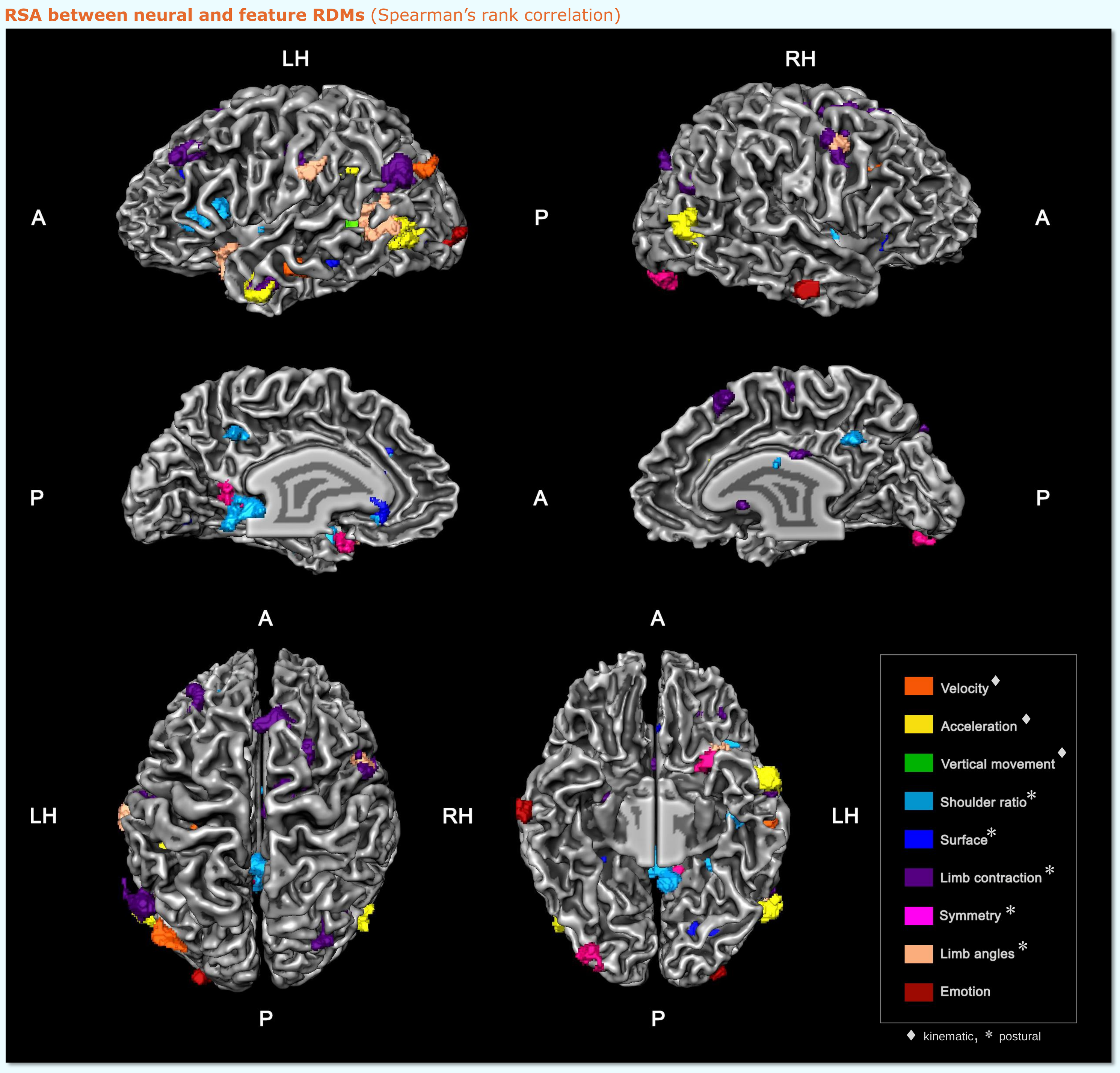


Searchlight RSA: pairwise-dissimilarities in the neural representation of videos (Pearson's r)



- The data of 13 participants were acquired on a 3T scanner (2x2x2mm, TR = 3s). Participants passively viewed a subset of the whole-body movement video stimuli (sixteen videos, six repetitions).
- The functional data was not spatially smoothed to preserve all information for the multivariate analyses.
- Neural RDMs were obtained after performing a whole-brain searchlight (radius = 5 voxels) RSA with trial estimates as input, for each participant individually **[4]**.
- Group analyses: neural RDMs were z-transformed and a one-sample t-test against 0 (2-tailed) was performed for each feature (Cluster size corrected, initial p = 0.005, Monte-Carlo simulation n = 5000).

RSA between neural and feature RDMs (Spearman's rank correlation)



Conclusion

Postural rather than kinematic features seem to be more relevant in the classification of emotion from whole-body movements. Moreover, postural and kinematic features activated different brain regions, indicating that these regions played a role in encoding these features. Our approach goes beyond classical methods of categorically mapping cognitive constructs to brain activation/deactivation and instead attempts to find a basis for affective body and action perception, looking for movement features and how they are encoded in the brain.

References

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Acknowledgements

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