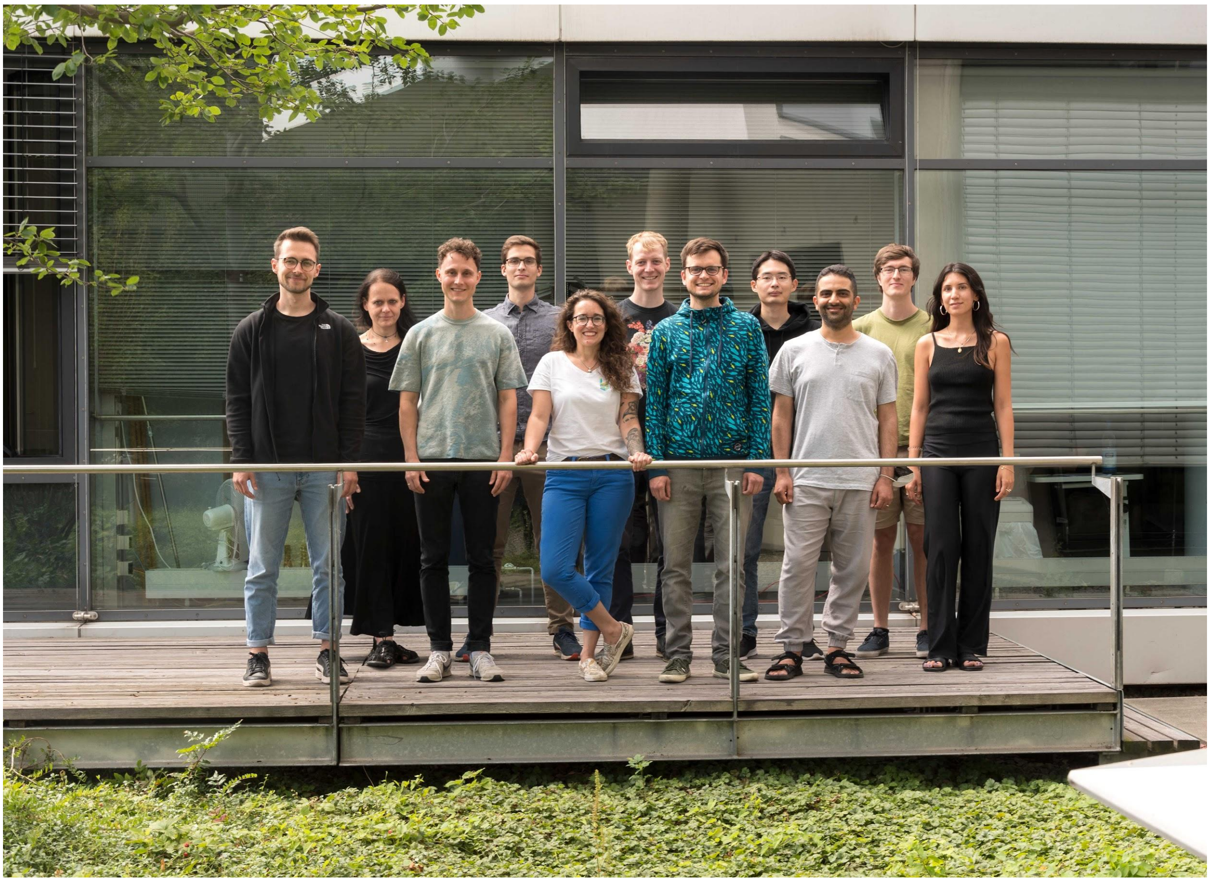
Name: Alireza Karami

Home lab: Center for Mind/Brain Sciences (CIMeC), University of Trento

Host lab: Max Planck Institute for Human Cognitive and Brain Sciences

Duration of stay: 2022/07/01 - 2022/08/31

I want to convey my thanks for receiving the **NENS exchange grant**, which allowed me to visit Dr. Martin Hebart's group at the Max Planck Institute for Human Cognitive and Brain Sciences from the first of July until the end of August. Having the opportunity to visit Dr. Hebart's lab helped me to work on the methodological aspect of my Ph.D. thesis and acquire new skills. Also, it helps me meet new people, become friends, and make new connections for further collaboration in the future.



During my short stay at Dr. Hebart's lab, I could achieve the goal I set before starting my journey. My general goal was to deepen my knowledge of the MVPA methods, mainly representational similarity analysis (RSA). In particular, I had two specific goals. First, I aimed to work on variance partitioning that is useful for interpreting the results from multiple regression RSA in the presence of multicollinearity and for performing model-based MEG-fMRI fusion [1]. Second, I aimed to learn feature-reweighted RSA [2]. This method aims to enhance the fit between computational models and the brain.

A network of regions in the frontal and parietal cortices in the human brain has been related to the capacity to estimate the number of objects in a set without counting. While there is an ongoing debate on the mechanisms underlying the emergence of a representation of numerosity in the brain, research on the neuronal underpinning of numerosity extraction is ongoing. While various behavioral findings support a dedicated system to extract numerosity from visual scenes, neuroimaging evidence is equivocal. Also, it is unclear whether the number signal comes from parietal cortices or is propagated from earlier visual areas.
My Ph.D. project aims to describe the different stages of information processing (in space and time) that, along the dorsal and ventral stream, support the emergence of a neural representation of numerosity in relation to the neural representation of other quantities, such as average item area and item density. Before visiting Dr. Hebart's lab, I collected MRI and MEG data in the CIMeC's Neuroimagein Labs (LNiF) from thirty human adult subjects, and the independent contributions of number and non-numeric features using multiple regression RSA of the MRI and MEG signals have been modeled. The next step of my research was to use the representational similarity-based fusion of MEG and fMRI data (Figure I) to analyze the geometry of the neural representations in different areas (with fMRI) and trace their emergence in time (with MEG). To do so, Dr. Hebart helped me better to understand the mathematics behind the method, variance partitioning, and its implementation in MATLAB. Also, Philipp Kaniuth, one of his Ph.D. students, helped me better understand how feature-reweighted RSA works to enhance the fit between fMRI and MEG data.

[1] Hebart, M. N., Bankson, B. B., Harel, A., Baker, C. I., & Cichy, R. M. (2018). The representational dynamics of task and object processing in humans. eLife, 7.

[2] Kaniuth, P., & Hebart, M. N. (2021). Feature-reweighted representational similarity analysis: A method for improving the fit between computational models, brains, and behavior. NeuroImage, 257.

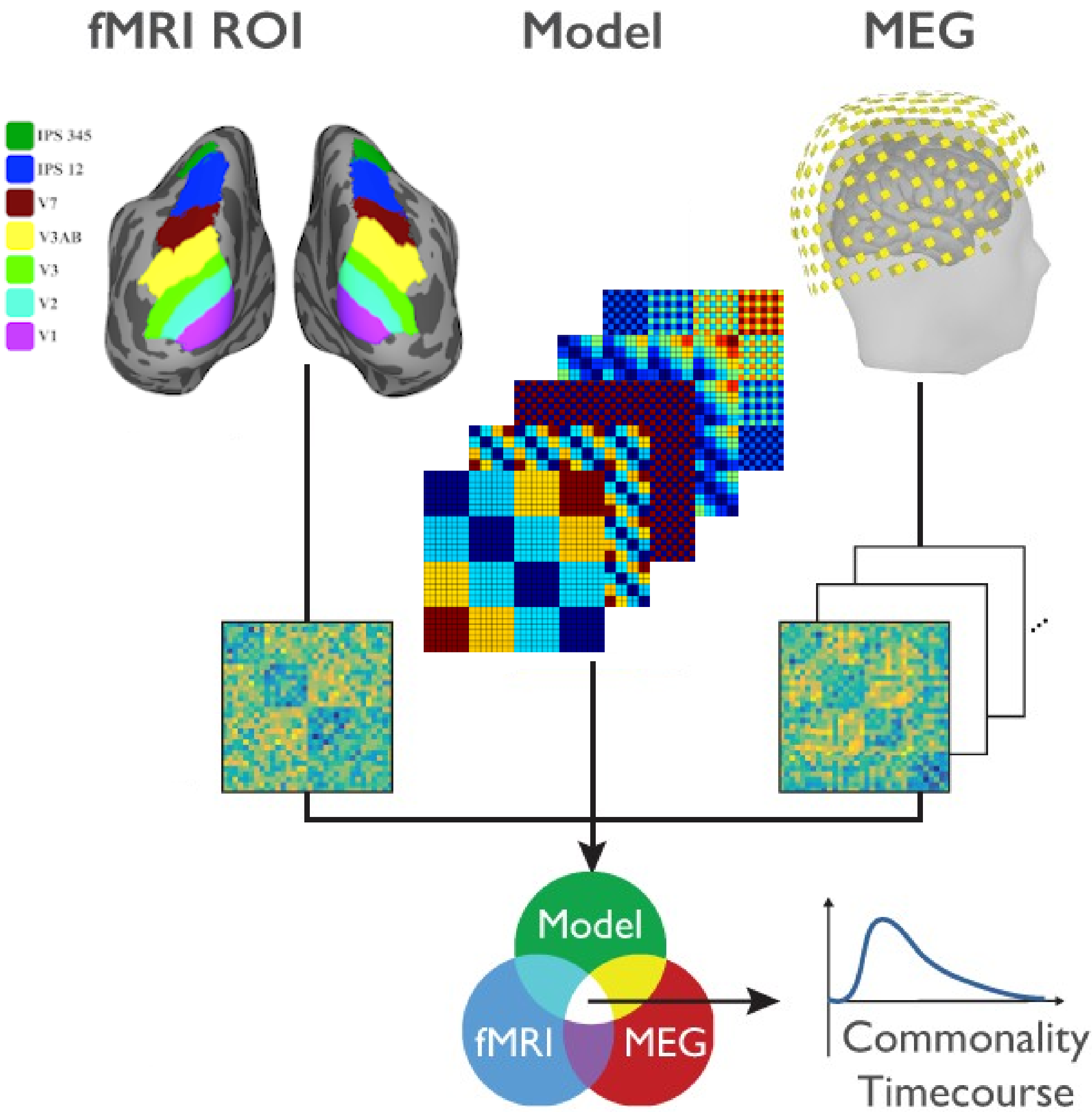


Figure I: *Figure adopted from Hebart et al., 2018*