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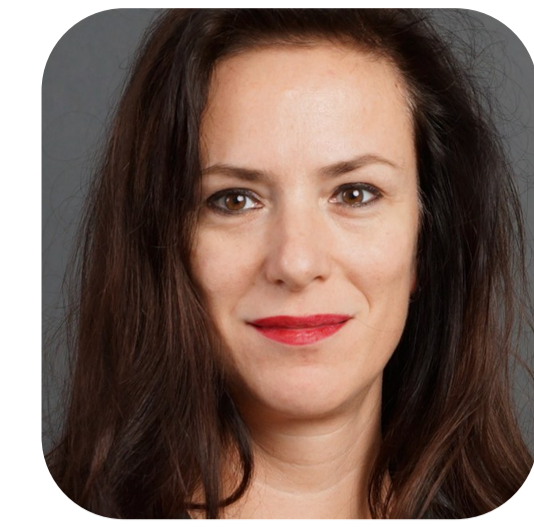*IN PUBLICA COMMODA SEIT 1737*

B1

The role of curiosity in guiding information integration in internal models of the world

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Motivation

- We sample sensory information to update our internal models of the world.
- It is unknown however, if and how the integration of sampled information is influenced by whether the information is obtained from curiosity-driven sampling or from more gradual sampling.

Preliminary work:

- Information in internal models of the world is visible in neural recordings as increased neural activity in alpha (~10Hz) and beta (15-15Hz) bands[1] (Fig. 1).
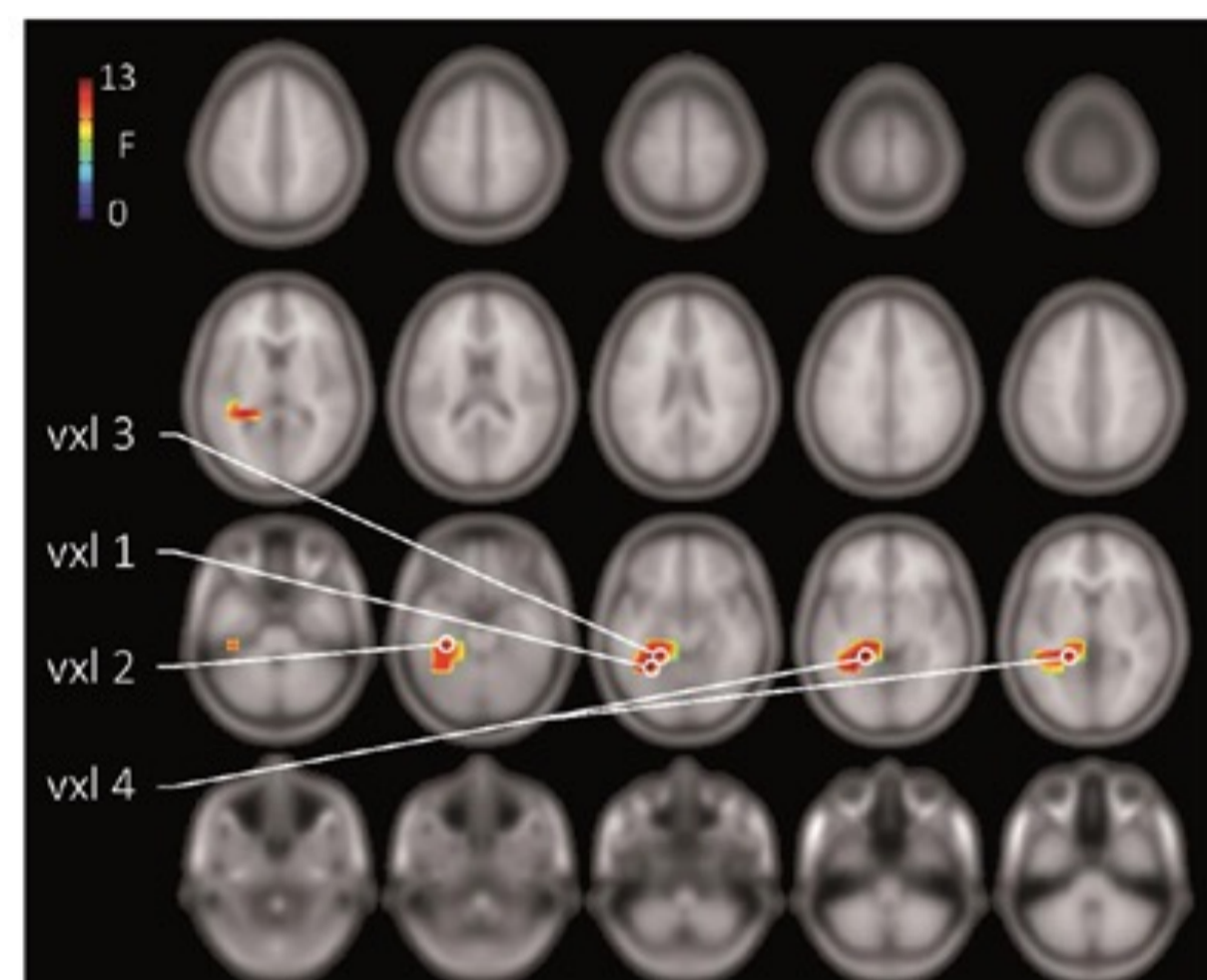

Fig. 1: Increased beta band activity with increased richness of an internal model (unpublished work)

Objectives

- How does a sampling strategy driven by curiosity change the integration of sampled information into internal models, compared to a gradual strategy?
- This project is theoretically motivated by predictive coding theories[3] and our own research on the neural representation of internals models[1]

➤ In analysing the consequences of curiosity on information integration in the brain, this project speaks to the question **Why are we curious?**

➤ By examining neurophysiological basis of self-chosen sampling strategies under curiosity this project also addresses the question **How are we curious?**

?   Does curiosity impact information sampling for the enrichment and extension of our internal models of the world?

Methods

- Large cohorts (N~100), EEG and anatomical MRI
- Task: Sampling of incomplete and degraded information under different sampling strategies (curious vs. gradual)
- Finite element modelling for high-fidelity source reconstruction
- Beamformer source analysis
- Information-theoretic analysis of network information flows[2]

Hypotheses:

- Our brains perform some form of predictive processing that requires acquiring and refining internal models of the world[3] via sampling from that world.
- Brain circuits will respond in distinctive ways to information sampled via curious strategies, delivering unpredictable information which fills and creates new knowledge gaps, versus more gradual sampling, where information gain is incremental.
- The differential brain-circuit responses to curious versus gradual sampling will exhibit interindividual differences.
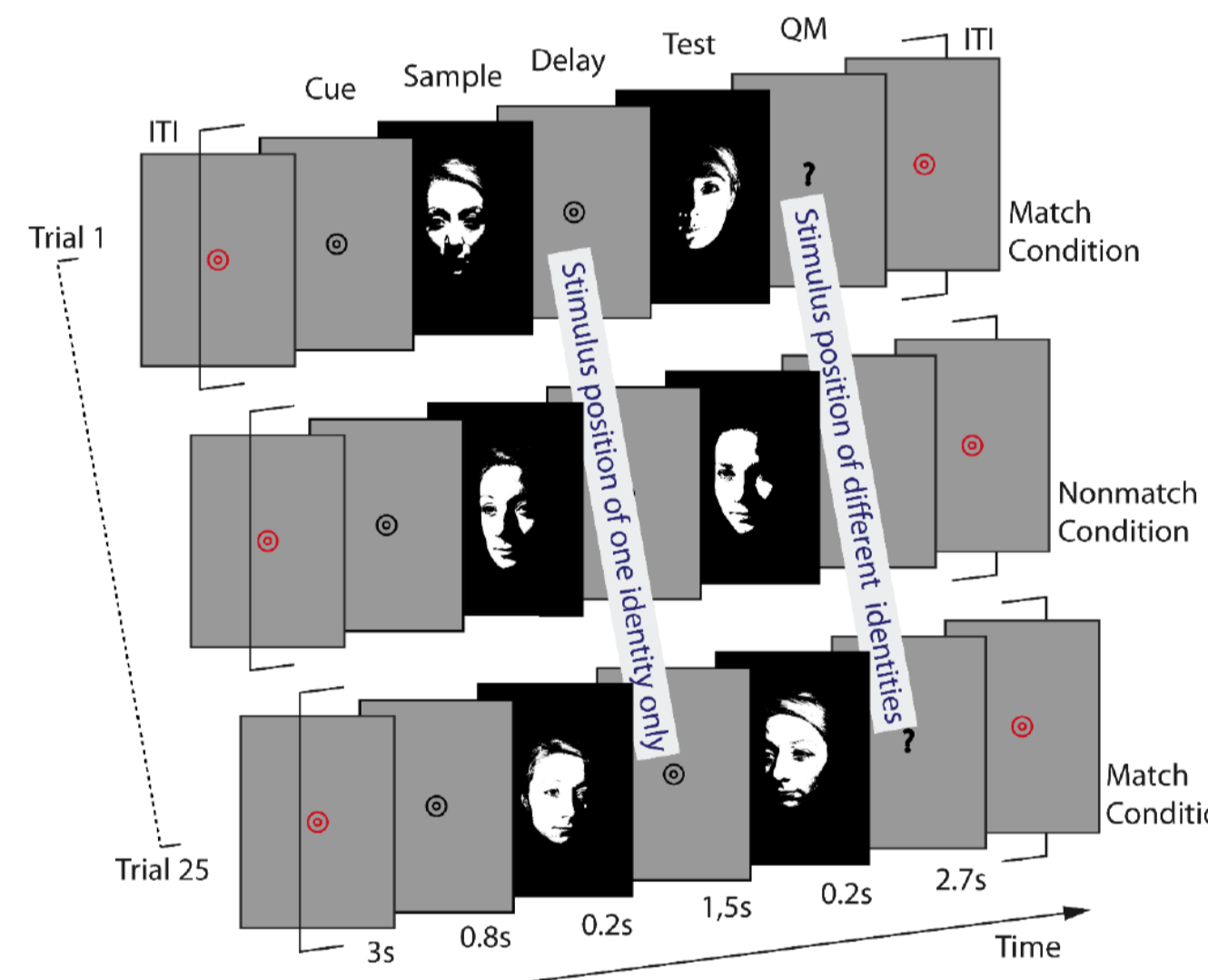

Fig. 2: Example of a behavioural curiosity task. Tasks in this project revolve around the acquisition of internal models of the outside world (here individual faces) from incomplete evidence via curious or gradual sampling strategies that change observation conditions differentially.

Fig. 3: (right) EEG recording- and analysis-pipeline including detailed head modelling, beamformer source analysis and analysis of network information flows.
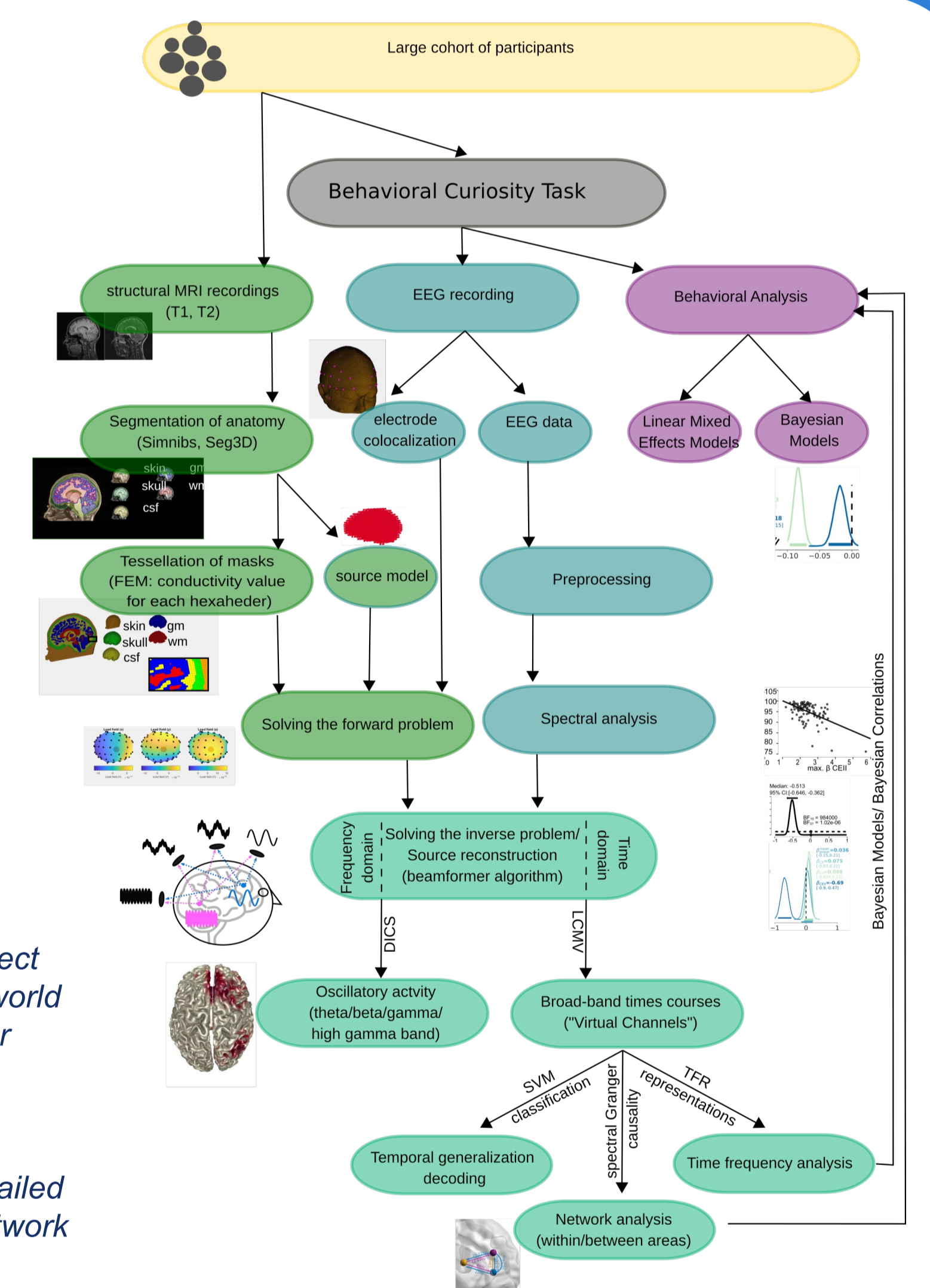
Cross-project collaborations

- Shared focus on different **sampling strategies** in experimental designs with **A4** (person-related factors), **C1** (perceptual sampling), **C5** (information theoretic aspects).
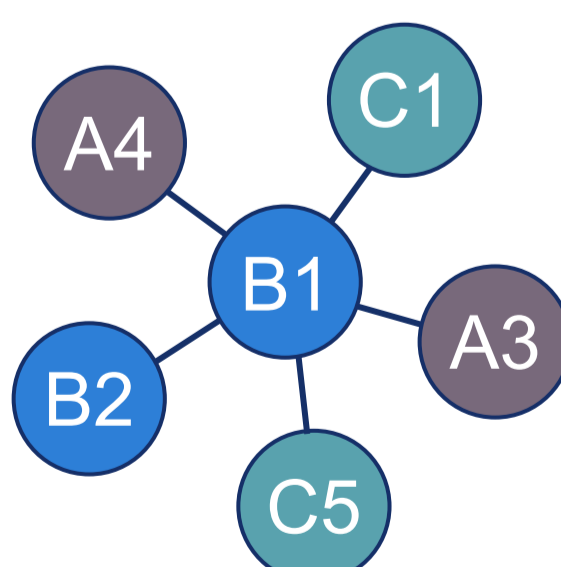- Shared focus with **A3**, **A4**, **B2**, **C1** on **individual differences**.

Fig. 4: Some key collaboration partners of the doctoral researcher working on Project B1.

Potential PhD projects

1. The neural bases of integrating predictable and surprising information into internal models
2. Intra- and interindividual[4] differences in the integration of information into internal models under curious versus more gradual sampling strategies
3. Affective and motivational influences on the neurophysiology of curiosity

References

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3. Mikulasch, F.A., Rudelt, L., **Wibral, M.** & **Priesemann, V.** (2023). Where is the error? Hierarchical predictive coding through dendritic error computation. *Trends in Neurosciences*, 46(1), 45-59.
4. Wilhelm, O., Herzmann, G., Kunina, O., Danthiir, V., **Schacht, A.** & Sommer, W. (2010). Individual differences in perceiving and recognizing faces - one element of social cognition. *Journal of Personality and Social Psychology*, 99(3), 530-548.