Representation learning for more reproducible fMRI data analyses
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**UNDERSTANDING VARIABILITY**

How does analytical variability vary with sample size? (Germani et al., 2022)

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**Replication learning for more reproducible fMRI data analyses**

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**SAME RAW DATA, DIFFERENT ANALYTIC PIPELINES**

- Neuroimaging workflows are highly flexible with many possible choices at each step of an analysis (Carp, 2012).
- However, different analytical choices can cause variation in the results (Botvinik-Nezer et al., 2020).
- This puts into question the validity of published results and calls for dedicated methodologies to handle this new level of variability (Dafflon et al., 2020).

> A better understanding of the relationships between results coming from different pipelines is essential in order to develop new methods to tackle this variability.

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**METHODS TO TACKLE THIS VARIABILITY**

Benefiting from data variability to build more generalizable brain decoding models (Germani et al., 2023a)

- Training effective Deep Learning models on fMRI data comes with challenges, especially lack of training data and large number of sources of variability in the data.
- Use of the NeuroVault (Gorgolewski et al., 2015) database: N=28,532 maps with unconstrained annotations.
- Pre-training of an unsupervised model (AutoEncoder) using NeuroVault and fine-tuning for classification tasks on smaller datasets.
- Better performance on small datasets and difficult classification tasks.
- Improved generalizability due to the ability of the pre-trained to focus on more general features and not on individual patterns of variability.

Code available at [gitlab.inria.fr/germani/self_taught_decoding/](https://gitlab.inria.fr/germani/self_taught_decoding/)

Transferring pipelines patterns between contrast maps

- Reusing fMRI maps processed with different pipelines can be difficult and augment the risk of having false positive findings (Rolland et al., 2022).
- We hypothesize that different pipelines can be seen as different styles applied to an fMRI map.
- Use of style transfer methods (Isola et al., 2018) to convert contrast maps between pipelines.
- Some patterns of a pipeline can easily be transferred between contrast maps (e.g., smoothing).
- Other parameters may display different patterns in contrast maps depending on specific properties of the data, making style transfer difficult to learn.

Code available at [gitlab.inria.fr/germani/pipeline_transition/](https://gitlab.inria.fr/germani/pipeline_transition/)

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**References**

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Klaas, S. et al., 2020. » Comparing the vibrations of effects due to model, data pre-processing and sampling uncertainty on a large data set in personality psychology. » Department of Statistics: Technical Reports.
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