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Functional Eigenmodes Enable Data-Efficient Precision Functional Mapping

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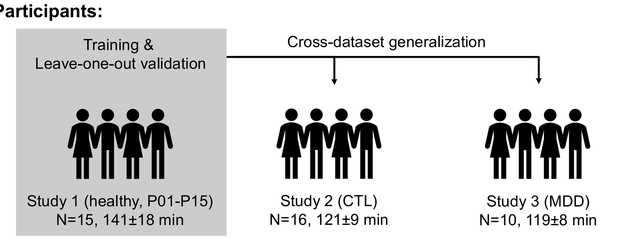
Harvard Medical School[1], Ecole Polytechnique Federale de Lausanne[2], Harvard University[3], University of Notre Dame[4], Massachusetts General Hospital[5], National University of Singapore[6]

Introduction

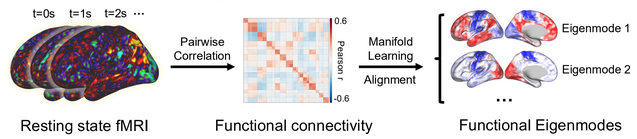
- Functional networks vary substantially across individuals[1-3]. Precision functional mapping reveals fine-scale network topography that group maps can obscure, but typically requires hours of fMRI data.
- Functional eigenmodes provide a compact representation of connectivity[4]. We observed that functional eigenmodes closely follow individual network topography, show similar eigenmode-network correspondence across individuals, and remain reliable even under limited data.
- Based on this, we developed Individual GENerative Mapping using eigenmodes (iGENMap). **iGENMap enables reliable within-individual network estimation from as little as 14 mins of data, suggesting that functional eigenmodes offer an efficient and robust representation of individual functional anatomy.**

Methods

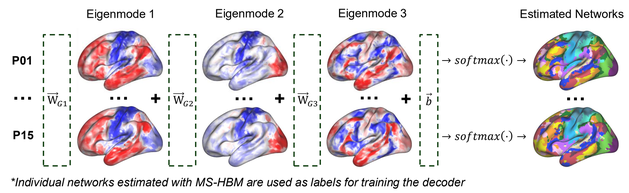
Participants:



Calculating functional eigenmodes:

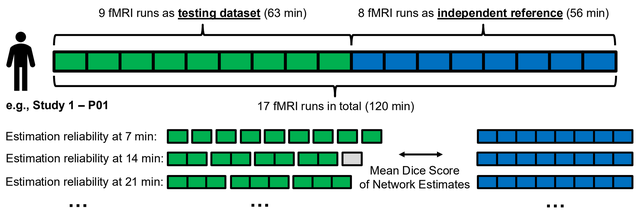


A shared decoder for estimating individual networks from eigenmodes



**Individual networks estimated with MS-HBM are used as labels for training the decoder*

Evaluating individual network estimation reliability



References

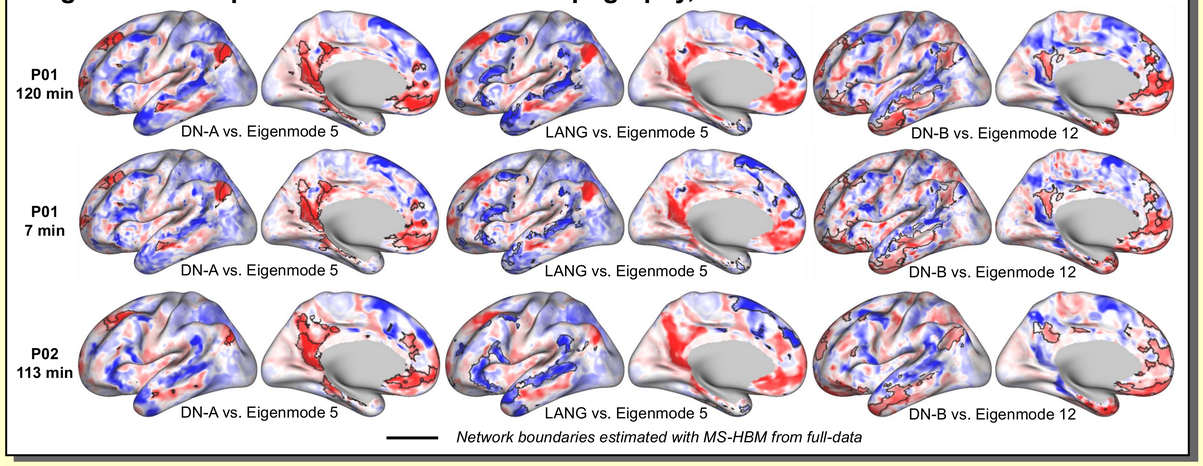
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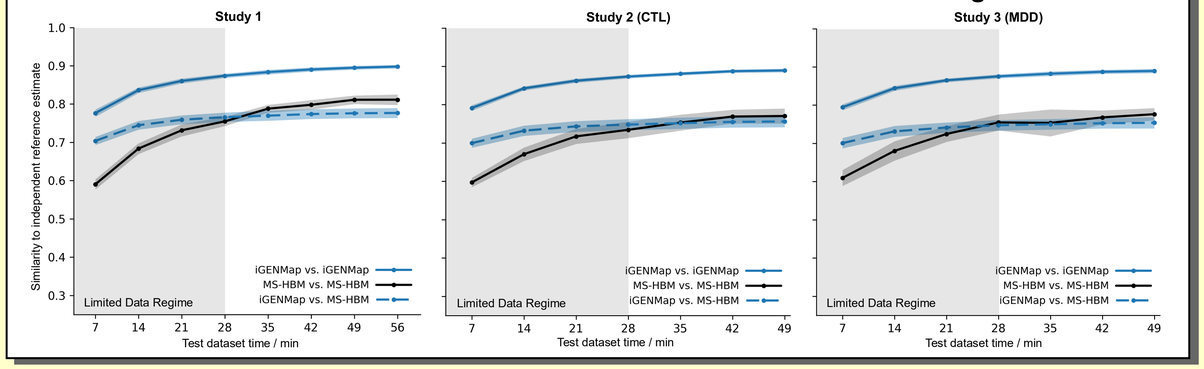
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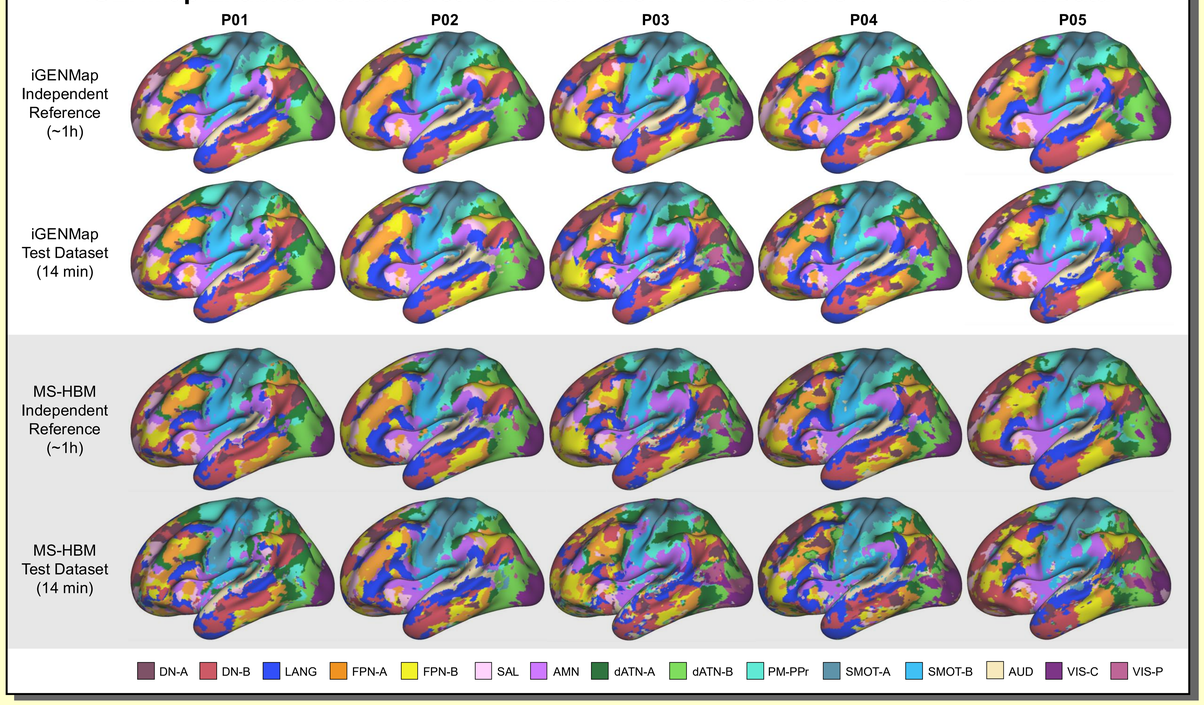
Eigenmodes Capture Individual Network Topography, and Remain Stable with Limited Data



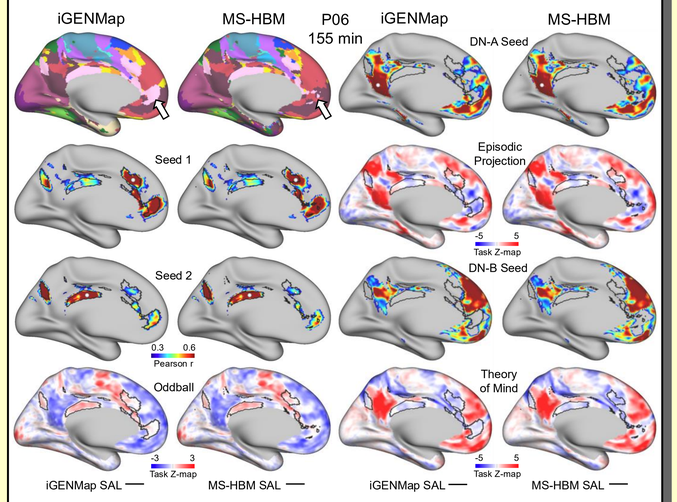
iGENMap Achieves Superior Estimation Reliability, and Closer Agreement with Independent Reference Estimates from Both Methods Under Limited Data Regime



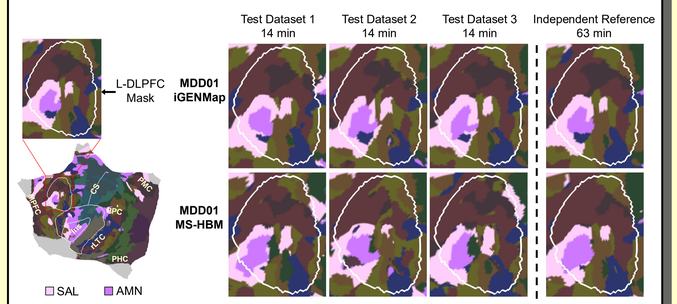
iGENMap Enables Reliable Network Estimation in As Short As 14 mins of fMRI Data



An Example Discrepancy Between iGENMap and MS-HBM Estimates Under Extensive Data



Reliable Mapping of L-DLPFC Networks for TMS Targeting in Depression from 14 mins of Data



Conclusion

- Functional eigenmodes offer compact representations of functional connectivity that preserve fine-scale individual network topography. Eigenmode-network correspondences are consistent across individuals.
- By training a shared linear decoder, we can resolve distinct individual functional networks from these functional features.
- iGENMap provides reliable estimates from less data than current state-of-art method. Reliable individual networks can be estimated from as little as 14 min fMRI data.
- More efficient individual mapping could bring precision functional mapping to large-scale datasets and within the reach for clinical care.

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