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H024 - Dimensionality reduction for analysis of functional connectivity in the developing human brain

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Aims Intrinsic functional connectivity (FC) observed in resting-state functional magnetic resonance imaging data is subject to dynamic processes that continue throughout life, most significantly in early childhood, putting the developmental aspect of this organization into focus. We propose a novel approach of applying dimensionality reduction for the analysis of the development of FC using a low-dimensional space to capture emergence of global functional connectivity.

Methods Locality preserving projection (LPP), a linear approximation of non-linear dimensionality reduction, transformed FC data into a space, where similarity of FC patterns defines distance between cortical nodes. Each subjects FC matrix was projected into a single shared embedding space derived from the cohort's group average FC matrix. In this space we performed analysis of changing patterns during maturation in healthy children (8-15y) of the ABIDE data set.

Results Underlying principles of organization present in large adult cohorts (Margulies et al., 2016) were confirmed in children. Regression analysis revealed significant age-dependent trends, showing a general trend of divergence during development both within networks (e.g. DefaultB - VisCent, slope: $0.4387*10^{-4}$) as well as between networks, except for the limbic network, showing convergence towards the other networks (e.g. limbicB - VisPeri, slope: $-0.3163*10^{-4}$). Clustering in embedding space revealed a default mode network (DMN) split into two clusters, separating the posterior cingulate cortex (PCC) from the DMN's prefrontal parts.

Conclusions We showed that age-dependent analysis of intrinsic FC in embedding space is a promising approach to broaden our understanding of the developing brain.