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The Canadian Dementia Imaging Protocol (CDIP): reproducibility of resting-state fMRI connectivity across sessions and sites in a human phantom

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Introduction

The *Canadian Dementia Imaging Protocol* (CDIP) was developed to harmonize acquisition parameters of various imaging sequences across MRI vendors and acquisition sites, with the ultimate objective of promoting big data sharing in initiatives such as the *Canadian Consortium for Neurodegeneration in Aging* (CCNA). We evaluated the reproducibility of findings for one CDIP imaging sequence, namely resting-state fMRI, across 2 separate sessions for each of 4 distinct sites (1 Phillips 3T Ingenia, 1 Phillips 3T Achieva, 2 Siemens 3T Tim Trio,) in a single human phantom (SD).

Methods

Functional T2*-weighted images were obtained using a blood-oxygen-level-dependent (BOLD) sensitive sequence (voxel size = 3.5x3.5x3.5mm^3, TR = 2110ms, 300 volumes). Structural T1-weighted scans were acquired using a MPRAGE sequence (voxel size = 1x1x1mm^{3,} TR = 2300ms). See http://www.cdip-pcid.ca for details. MRI data were preprocessed and analyzed with NIAK (http://simexp.github.io/niak/). Resting-state fMRI connectivity maps were extracted for each session per site, by computing separately the correlations between the time series of every voxel and the average signal in 7 pre-defined functional networks that covered the whole brain.

Results

The reliability of findings was qualitatively assessed through the correlations of connectivity maps between sessions and sites. Results were averaged over networks. The mean correlation (Pearson coefficient r) for pairwise comparisons between all 8 sessions was 0.55±0.13 (mean ± std), indicating a moderate to good reproducibility. The high variability was explained by differences between sites with Siemens vs Phillips scanners, with within-site mean correlations between sessions of 078.±0.003 and 0.47±0.03, and between-site correlations between sessions of 0.77±0.02 and 045.±0.08, respectively. Critically, however, estimation of motion of the human phantom was much different between Siemens and Phillips (mean frame displacement = 0.16±0.02 and 0.36±0.08).

Conclusions

Within-site and between-site correlations of connectivity maps between sessions were very similar, when looking separately at Siemens (low motion) and Phillips (high motion) scanners. This finding supports the usefulness of a multisite approach to data acquisition for resting-state fMRI for some sites. Further work is needed to disambiguate the impact of scanner type vs motion in cases of lower reliability.