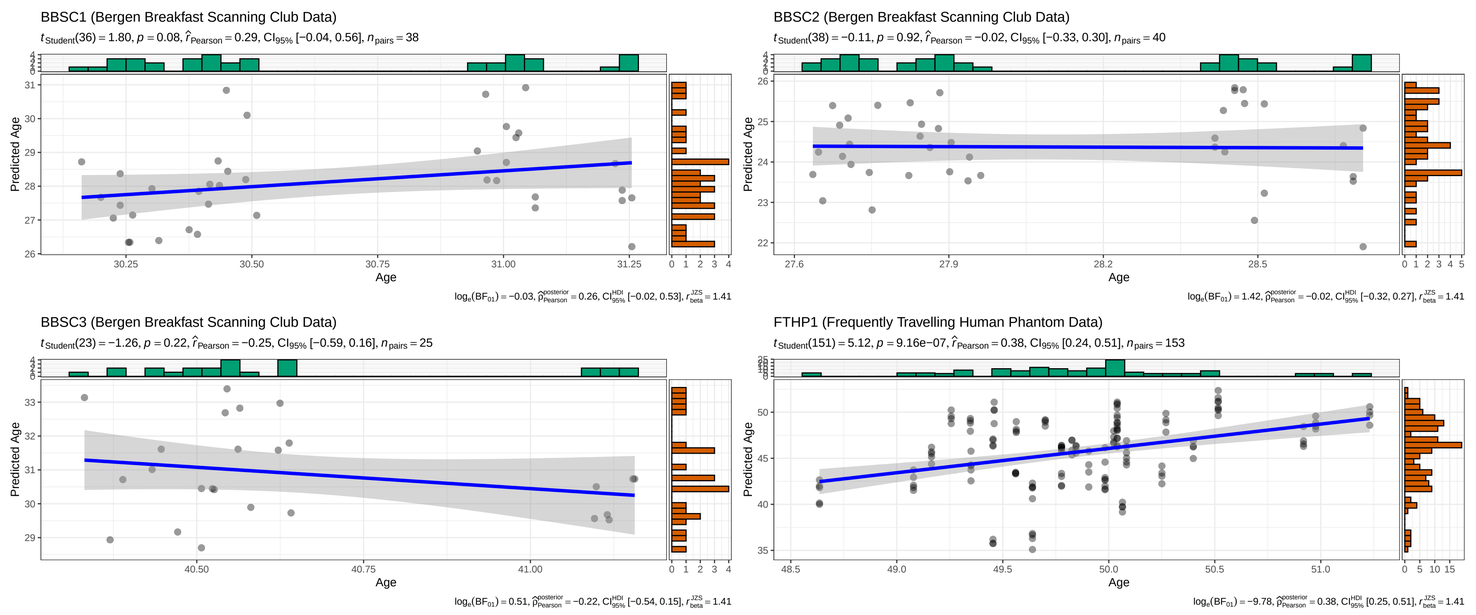
Field strength and scan quality influence brain age estimates

Brain age predictions in longitudinal data reveal the importance of scan quality and field strength

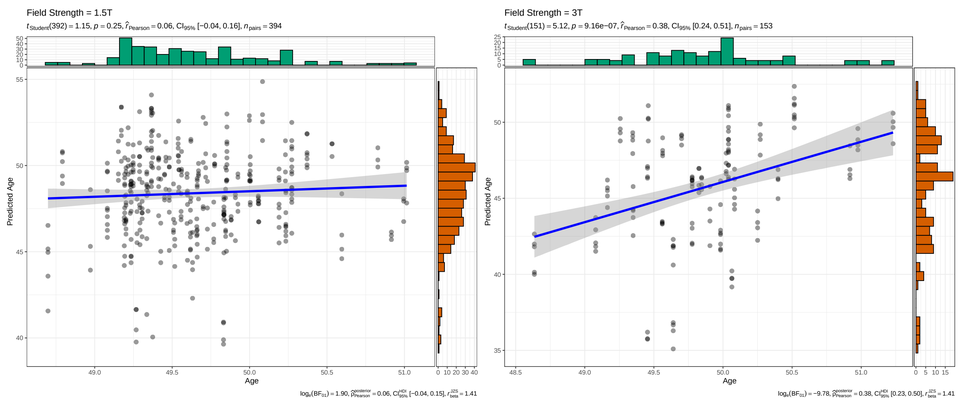
Background: Brain age is a promising biomarker of brain or general health. However, to extend the metric's clinical applications, the large intra-individual varibility in age predictions needs adressing.

Method: We used the pre-trained deep neural network *pyment* to predict brain ages from densly sampled T1-weighted magnetic resonance imaging data from three individuals (BBSC1-3) scanned in total $N_{BBSC} = 103$ times over a one-year interval, and an independent data set including one individual (FTHP1) scanned $N_{FTHP} = 557$ times over a three-year interval.

Result 1: Crude within-subject correlations between age and brain age revealed differing directionalities of slopes across subjects, with the correlation being only statistically significant in FTHP1.



Result 2: Field strength was revealed as only significant effect on brain age in FTHP1 in a random intercept model (β = -1.141, $p_{Holm} < .001$).



Result 3: Quality control (QC) measures entropy-focus criterion (EFC, β_{std} = -0.489, $p_{Holm} < .001$) and the foreground-background energy ratio (FBER, β_{std} = 0.456, $p_{Holm} < .001$) were significant predictors of brain age in BBSC1-3 in a random intercept model at the participant level. No QC measures were associated with FTHP1's brain age.

Conclusion: Brain age estimates are potentially influenced by acquisition parameters and scan quality. An avenue for future brain age modelling could be to employ multiple, more specific models, tuned to developmental and individual differences and acquision parameters.

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