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# MACHINE INTELLIGENCE TO PREDICT HUMAN INTELLIGENCE

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**Purpose:** Intelligence quotient (IQ), the proxy of a person's neurocognitive ability, is an important factor in a person's health and socioeconomic status. Accurate prediction of a person's future course of IQ may boost individual potential as well as help in clinical support on intervening early and changing the course for those vulnerable. State-of-the-art convolutional neural networks (CNNs) showed great promise in medical imaging (e.g., magnetic resonance imaging (MRI))-based predictive tasks yet predicting a person's IQ level from brain MRI is not a trivial task. In this study, we have conducted a feasibility study using state-of-the-art CNNs in predicting IQ scores from brain MRIs.

**Materials and Methods:** This study used 2D and 3D CNNs on T1-weighted brain MRI (sMRI) from autism brain imaging data exchange (ABIDE I; Age: 16.79±7.28 years, Range: 6-64 years, Male: 85.29%), to predict full-scale IQ (FIQ), performance IQ (PIQ), and verbal IQ (VIQ). We used 2D ResNet18 and VGG8, and 3D DenseNet264 and ResNet18. For each CNN, we performed a 5-fold cross-validation. We trained models in two settings: predicting three IQ scores separately (i.e., FIQ or PIQ or VIQ), and simultaneously (i.e., FIQ and PIQ and VIQ).

**Results:** In single IQ prediction studies, mean Pearson's correlations (averaged over 5-folds) between the CNN-predicted and "true" IQ scores are: 2D ResNet18 [FIQ: 5.61%, PIQ: 7.15%, VIQ: 4.62%] ($p>0.01$); 2D VGG8 [FIQ: 6.59% ($p>0.01$), PIQ: 5.84% ($p>0.01$), VIQ: 17.03% ($p<0.01$)]. For simultaneous IQ prediction studies: 2D ResNet18 [FIQ: 22.18%, PIQ: 16.13%, VIQ: 19.03%] ($p<0.01$); 2D VGG8 [FIQ: 13.64%, PIQ: 12.54%, VIQ: 10.48%] (in all cases, $p<0.01$); 3D DenseNet264 [FIQ: 2.56%, PIQ: 0.51%, VIQ: 4.18%] ($p>0.01$); 3D ResNet18 [FIQ: 16.8%, PIQ: 12.3%, VIQ: 15.6%] ($p<0.01$).

**Conclusion:** Our results depicted that the high-performing 2D and 3D CNNs perform poorly in predicting FSIQ, PIQ, and VIQ scores from sMRI. The results are similar to CNN-based fluid score prediction in the ABCD dataset. This performance raises several questions, e.g., is 850 training samples sufficient? Are state-of-the-art CNNs able to capture the IQ-specific discriminatory features in the brain sMRI? Our future work aims to study these issues.