What can brain imaging and AI reveal about an individual person?

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Psychometric assessment: Measuring candidates

Psychometric testing
General Aptitude and specific cognitive skills
Personality, i.e., behavioral tendencies
A critical assessment of assessment practices

Are measurements meaningful?

Relationship test - concept
Relationship concept - outcome

Outcome related to mental traits
Inference on mind from behavior
Can we skip the noisy readout?
Structural MR imaging: Measuring the brain
The limits of classical (associative) statistics

Successful trainees scored significantly higher on the XBT aptitude test (bars show mean and standard error)

More honest plot (same data)

Groups indistinguishable (AUC = .58)

When something is true on average, it may still be untrue for many
Classical statistics vs. machine-learning

Multivariate patterns can greatly increase predictive power
-> Machine-learning / AI

Most relevant questions focus on statements about new cases
Out-of-sample prediction

Hight Comparison $p = 0.112$
Weight Comparison $p = 0.133$
Classification Accuracy: 94.5%
Machine-learning of MRI–phenotype relationships

37 y, ♂□, good
52 y, ♀□, bad
65 y, ♀, fair
71 y, ♂□, good
44 y, ♂□, good
28 y, ♀, fair

Train Model

28 y, ♀, good
Predicting individual information from MRI scans

Chronological age

Age estimated from MRI

Quantitative judgment of the model

88% correct
Brain age as a marker of cognitive status

Does BrainAge indicate cognitive status?
Functional MR imaging: Network dynamics
Functional MR imaging: Network dynamics

Language

Social cognition

Working memory

Movement
Predicting individual traits from network dynamics
Predicting individual traits from network dynamics

Emotional instability (predicted)

Emotional instability (questionnaire)

Emotion processing network
Predicting individual traits from network dynamics

Cognitive action control: Cieslik et al., 2015

Social-affective network: Amft et al., 2014

\[ r = 0.51 \quad \text{Working memory for actions} \quad r = 0.13 \]
The future of work – individual assessment by AI?

Disruptive potential
- Direct assessment of mental traits
- Objective and unbiased inference
- Not reliant on theoretical constructs

Broad perspectives
- Medical focus funding-driven
- Target vector can be anything
- Inference on future outcomes
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