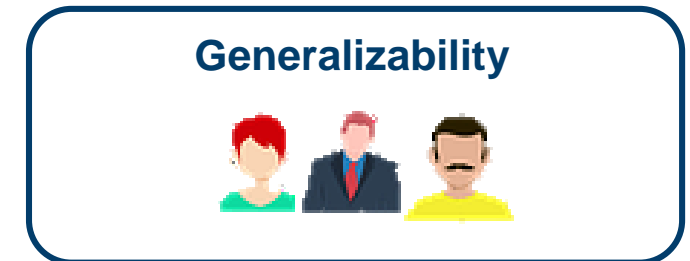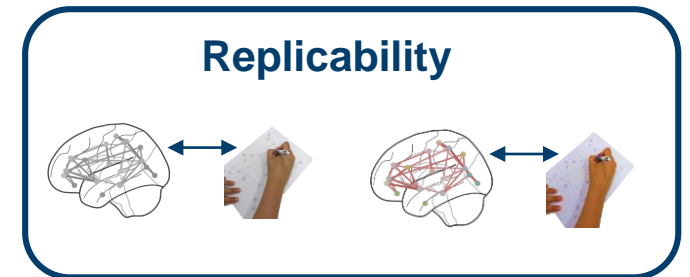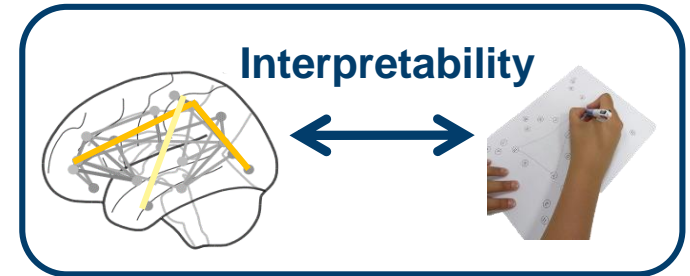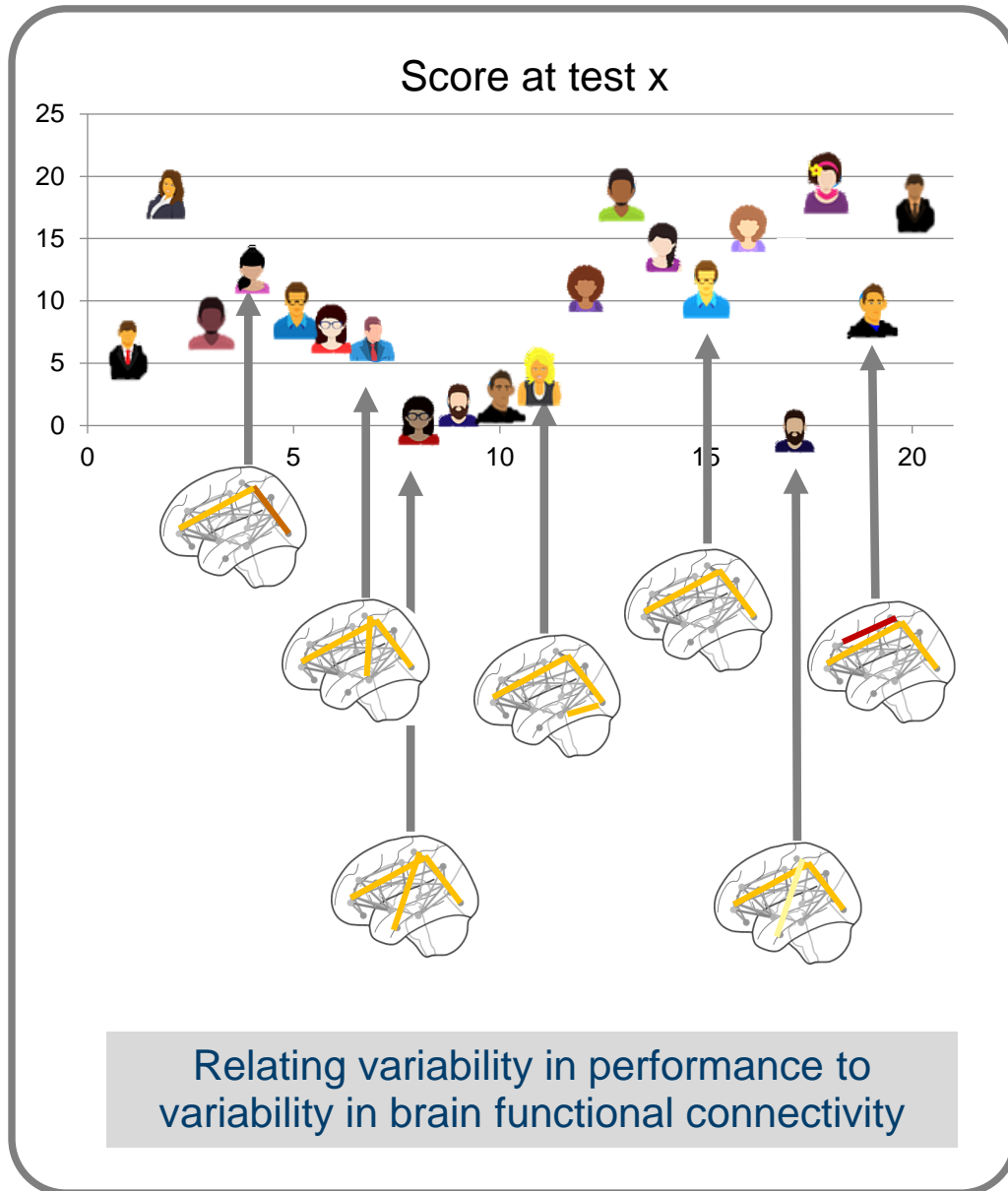# Generalizability of connectome-based predictive models

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# Connectivity-based psychometric prediction

Score at test x

Relating variability in performance to variability in brain functional connectivity

Interpretability

Replicability

Generalizability

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Predictive models of psychometric data: biases in population minority
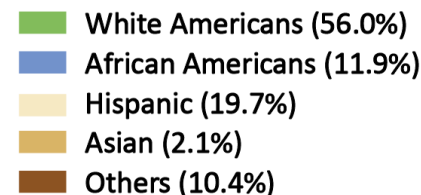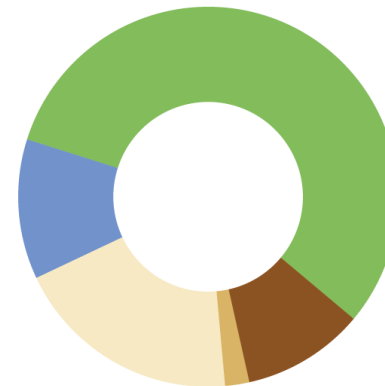
Human Connectome Project (HCP)

- N = 948; 22-37years
- 58 behavioral measures
- #WA = 721, #AA = 129
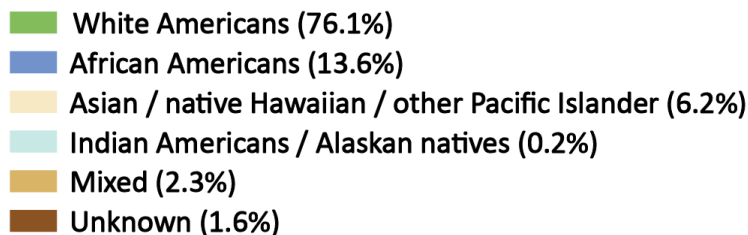
Adolescent Brain Cognitive Development (ABCD)

- N = 5351; 9-11years
- 36 behavioral measures
- #WA = 2997, #AA = 642

Legend (HCP):
- White Americans (76.1%)
- African Americans (13.6%)
- Asian / native Hawaiian / other Pacific Islander (6.2%)
- Indian Americans / Alaskan natives (0.2%)
- Mixed (2.3%)
- Unknown (1.6%)

Legend (ABCD):
- White Americans (56.0%)
- African Americans (11.9%)
- Hispanic (19.7%)
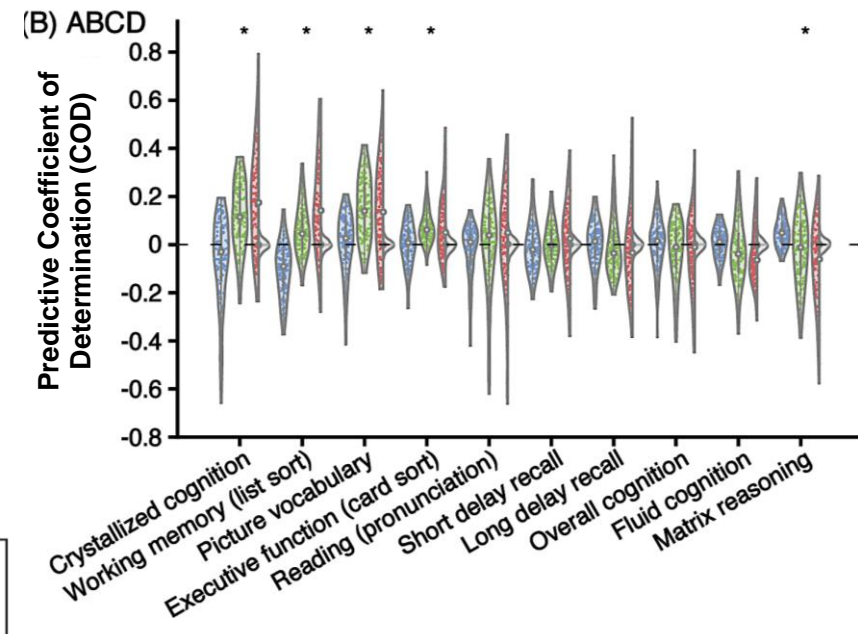- Asian (2.1%)
- Others (10.4%)

Predictive models of psychometric data: biases in population minority

LARGER PREDICTION ERROR IN AFRICAN AMERICANS THAN MATCHED WHITE AMERICANS

Human Connectome Project (HCP)
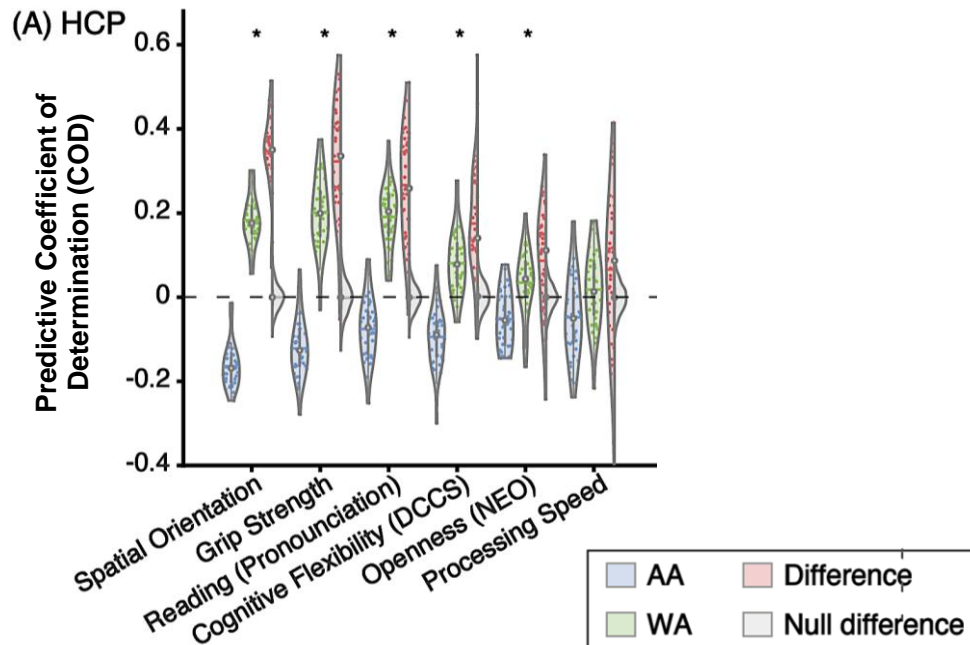
Adolescent Brain Cognitive Development (ABCD)

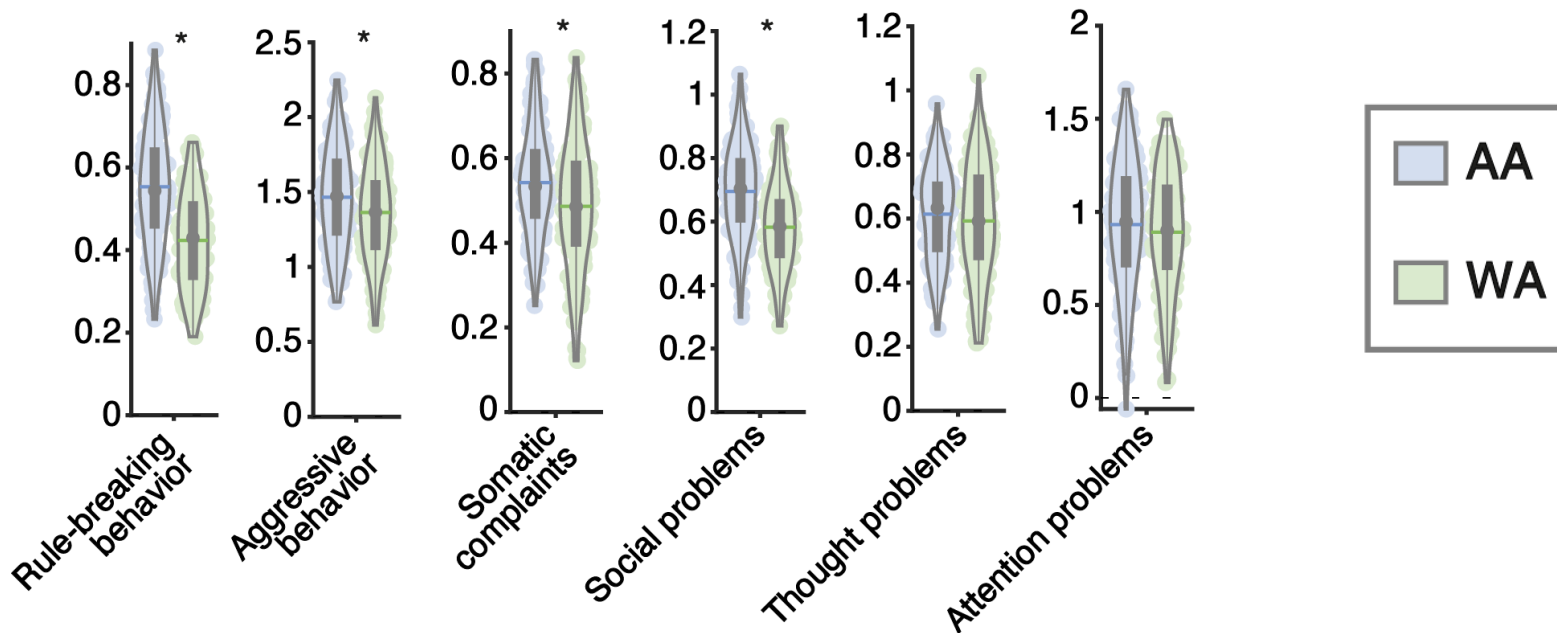Only predictable behavioral measures are shown here.

Similar pattern by looking into all behavioral measures, or regressing different confounds, or modelling with a different algorithm.

Predictive models of psychometric data: biases in population minority

DIRECTION OF PREDICTION ERROR & POTENTIAL CONSEQUENCES

Predicted – observed behavioral scores

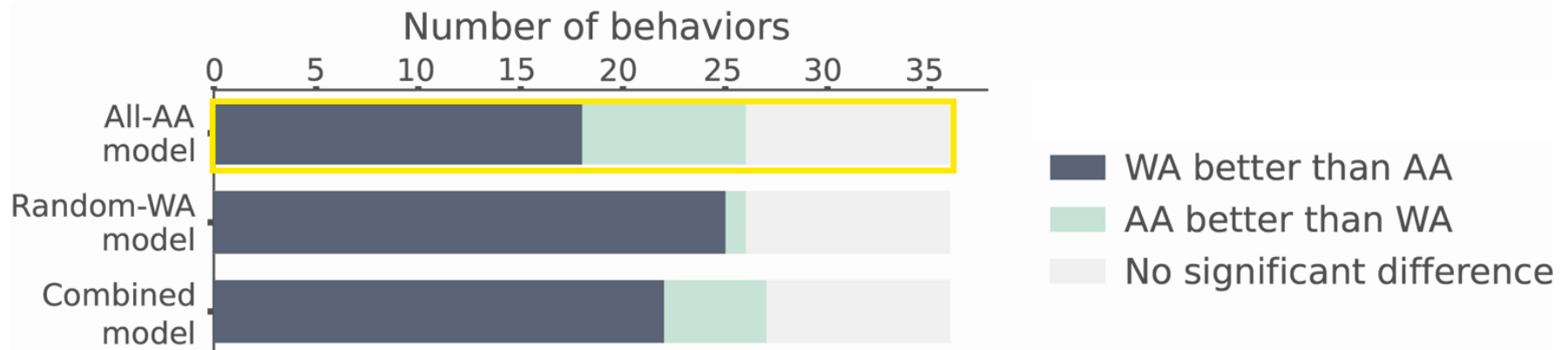ABCD data - Achenbach Child Behavior Checklist

Predictive models of psychometric data: biases in population minority

EFFECTS OF TRAINING POPULATION

ABCD dataset

Compare 3 types of models, trained on:

a. AA only
b. WA only (same sample size as AA)
c. Half AA, half WA (combination of *a.* & *b.*)

- Training only on AA helped to reduce prediction bias against AA

- Prediction accuracy was still in favor of WA

    - Brain Imaging side:
      preprocessing strategies/parameters were optimized on white-dominated samples (e.g. brain templates, functional atlases)

    - Behavioral side:
      standard measures (or tools) suitable / valid for minorities?

- Call for more data collection from non-European-descendant / non-white populations, to learn better representation of minor populations.
    - Consider even more minor groups (e.g. native Americans in the US population)
    - Africans in Africa ≠ African Americans

- Subgroups in the currently defined ethnic/racial categories (e.g. Chinese vs Indian, both as "Asian")
    - Be aware of similar issue in other countries (e.g. Chinese datasets dominated by Han)
    - Other minority groups, e.g. lower social class

- Assess & promote fairness of future artificial intelligence applications across populations.

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Thank you

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Bertrand Thirion

Demian Wassermann

UCL (UK)

Janaina Mourao-Miranda

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