



One size does not fit all: neural correlates of high performance are different for children in poverty

Monica E. Ellwood-Lowe

Psychology and Economics of Poverty Convening | April 1, 2022



Susan Whitfield-Gabrieli



Carolyn Irving



Silvia Bunge

With support from:

- the massive efforts of the large team of ABCD leaders and organizers, staff and data curators, and families and children who participated
- ABCD Workshop on Brain Development and Mental Health (Award Number R25MH120869)
- National Science Foundation Graduate Research Fellowship
- Jacobs Foundation Advanced Career Research Fellowship
- PEP seed funding grant
- ICBS seed funding grant
- Building Blocks of Cognition Lab
- Language and Cognitive Development Lab

Poverty Disturbs Children's Brain Development and Academic Performance

Delayed brain development predicts lower tests scores in low-income children

NEUROSCIENCE

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News > Science

Poverty changes your brain to make you less intelligent, study suggests

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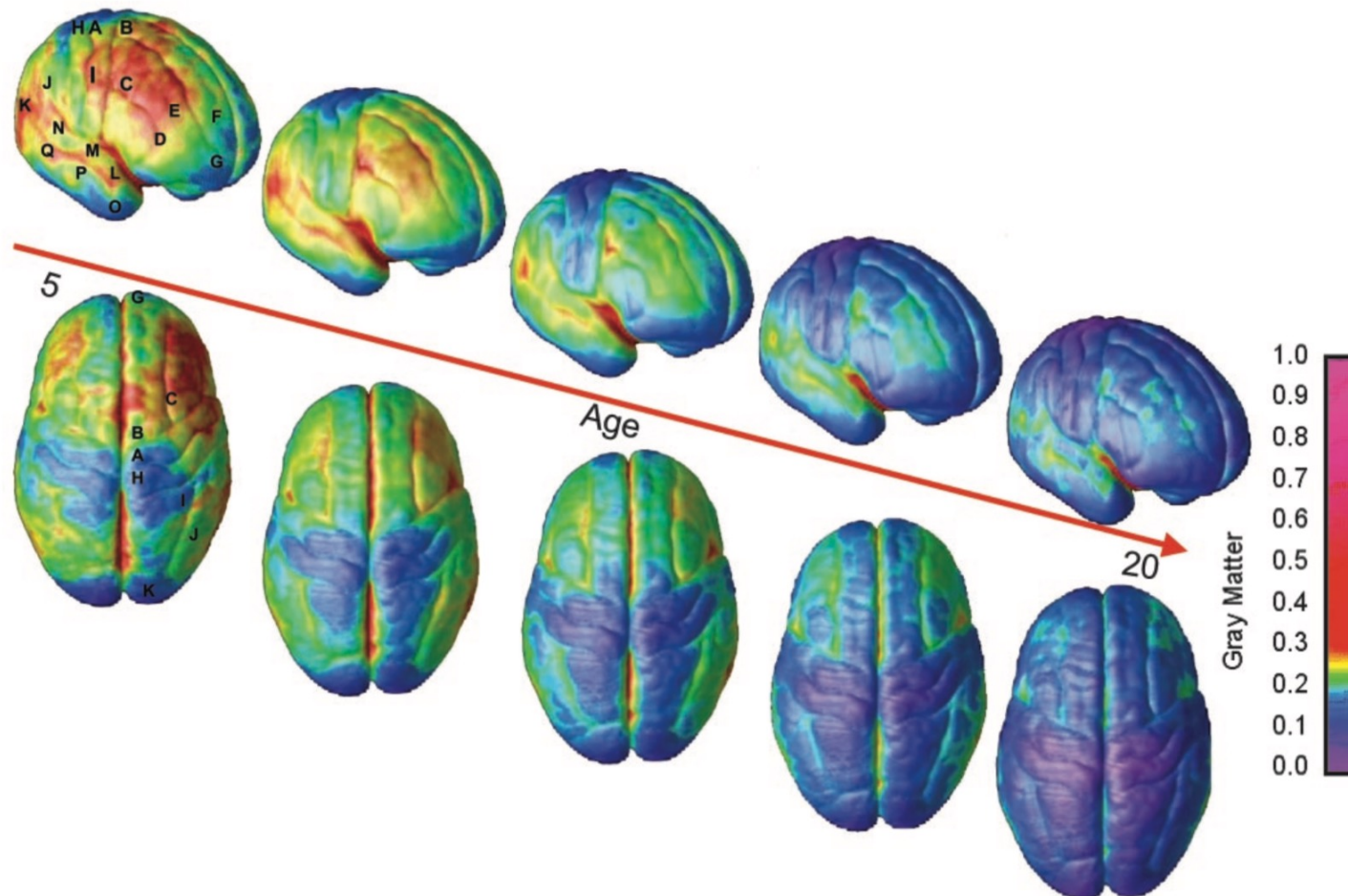
Poverty changes your brain to make you less intelligent, study suggests

HEALTHCARE & PHARMA

AUGUST 29, 2013 / 11:06 AM / UPDATED 9 YEARS AGO

Study finds poverty reduces brain power

What is “normal” brain development?



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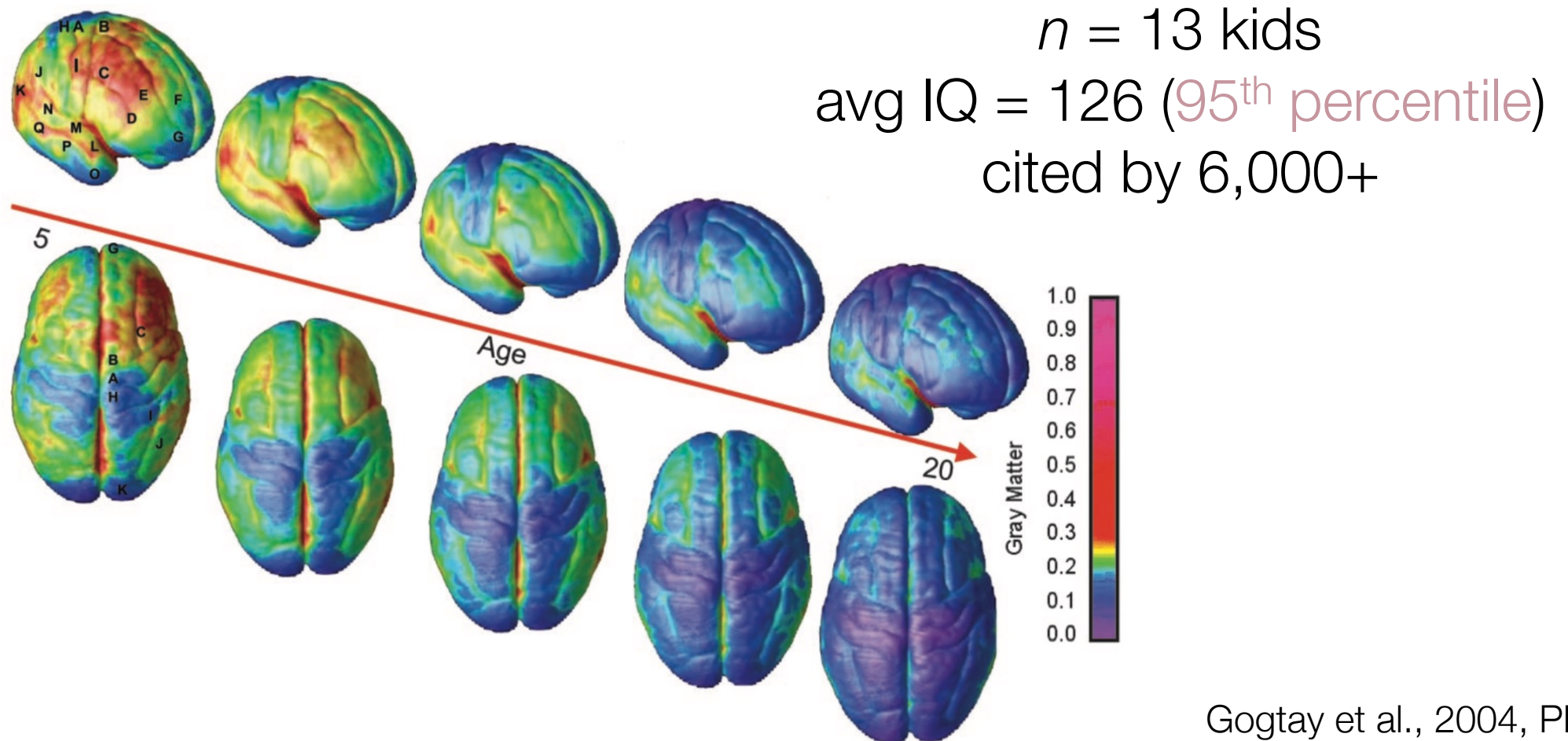




Image: Getty Images
Video: <https://www.youtube.com/watch?v=hvXoHU9Cexk>





- $n = 11,000+$ kids
- 21 sites across the United States
- Beginning at age 9-10 years
- Will be followed through age 18



Children from higher-income homes tend to score higher on cognitive tests



Susan Whitfield-Gabrieli



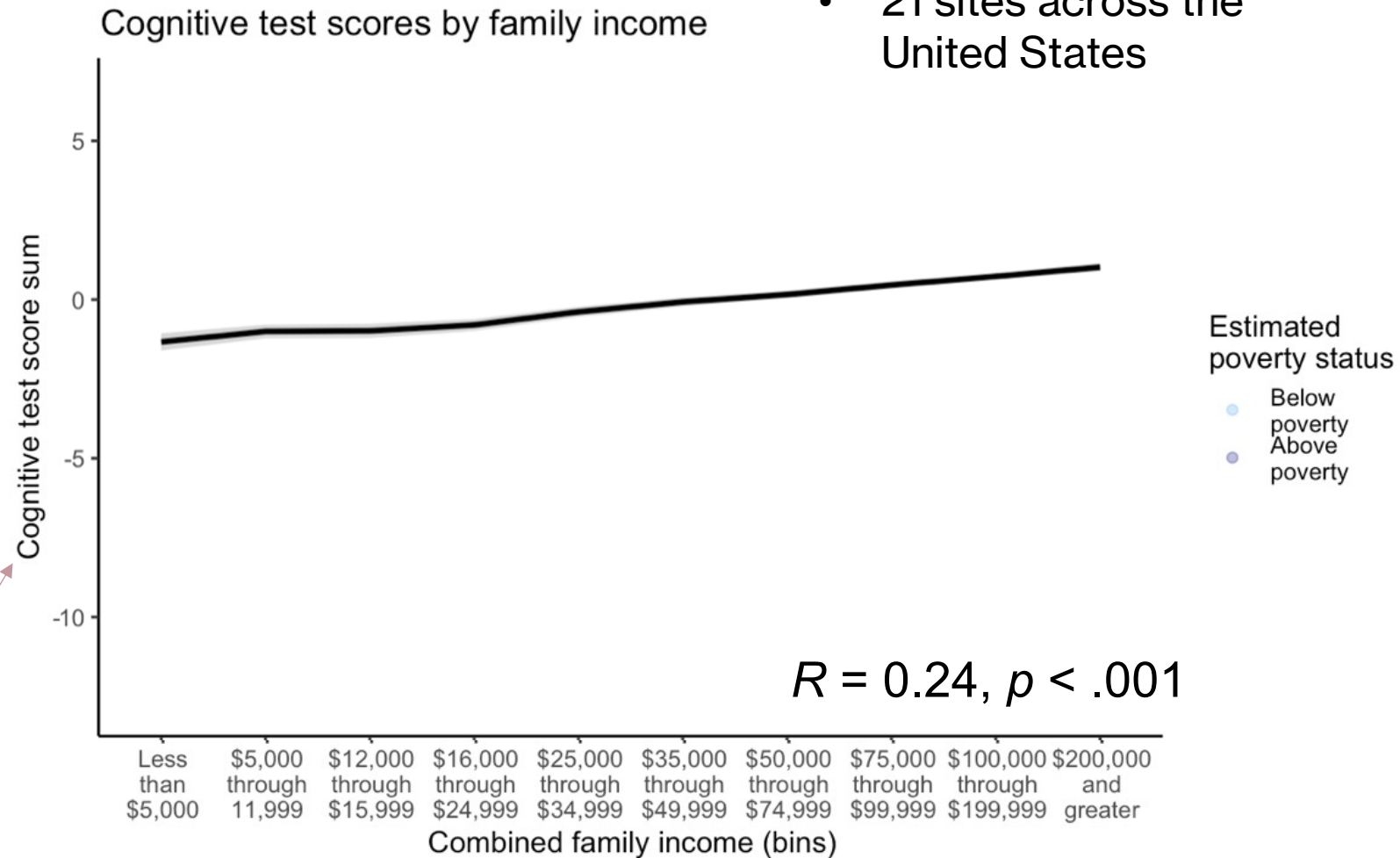
Silvia Bunge

Ellwood-Lowe, Whitfield-Gabrieli, & Bunge, 2021, *Nature Communications*

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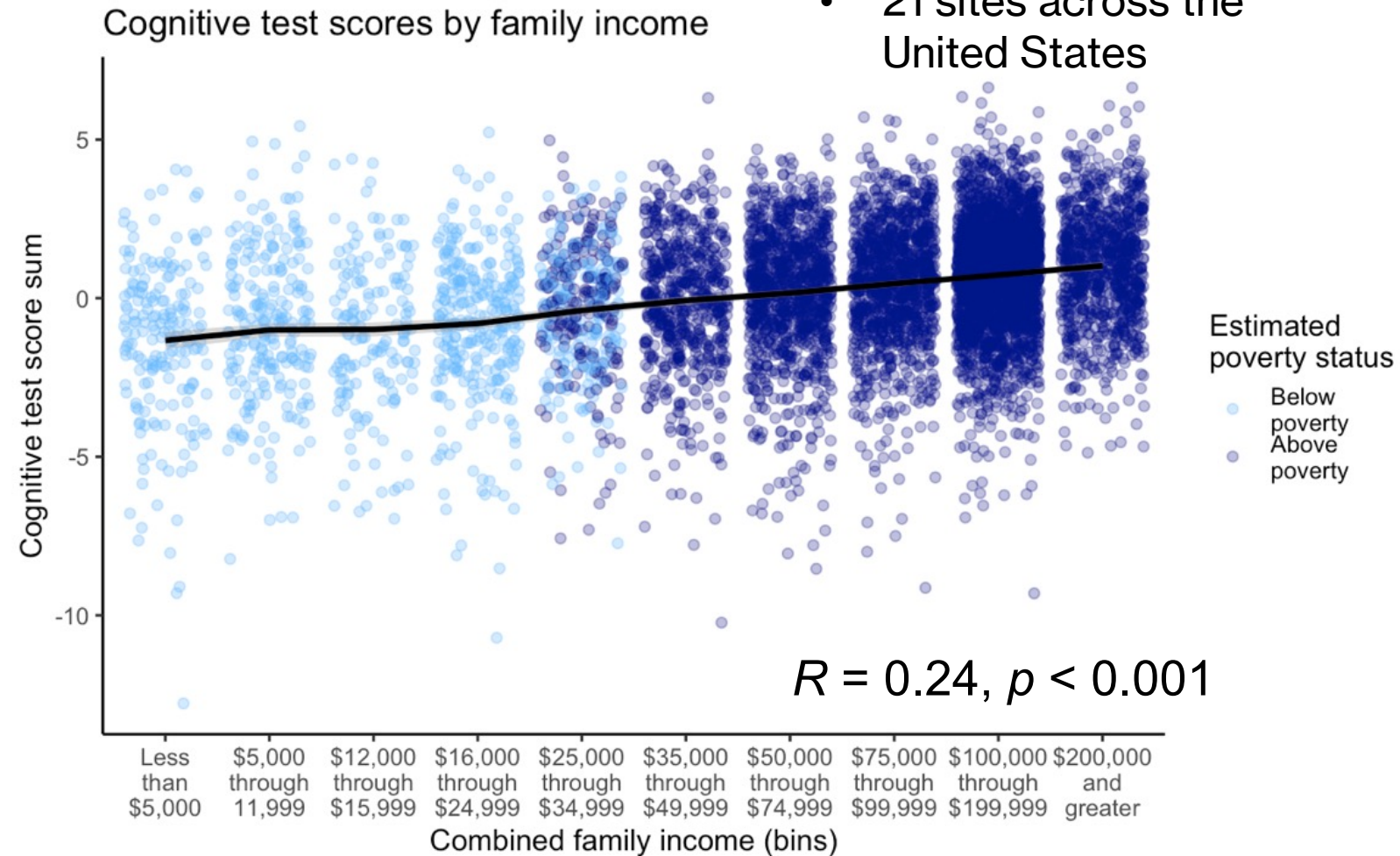
working memory,
inhibition, & reasoning

- ABCD study
- $n = 6,839$
- ages 9-10 years
- 21 sites across the United States



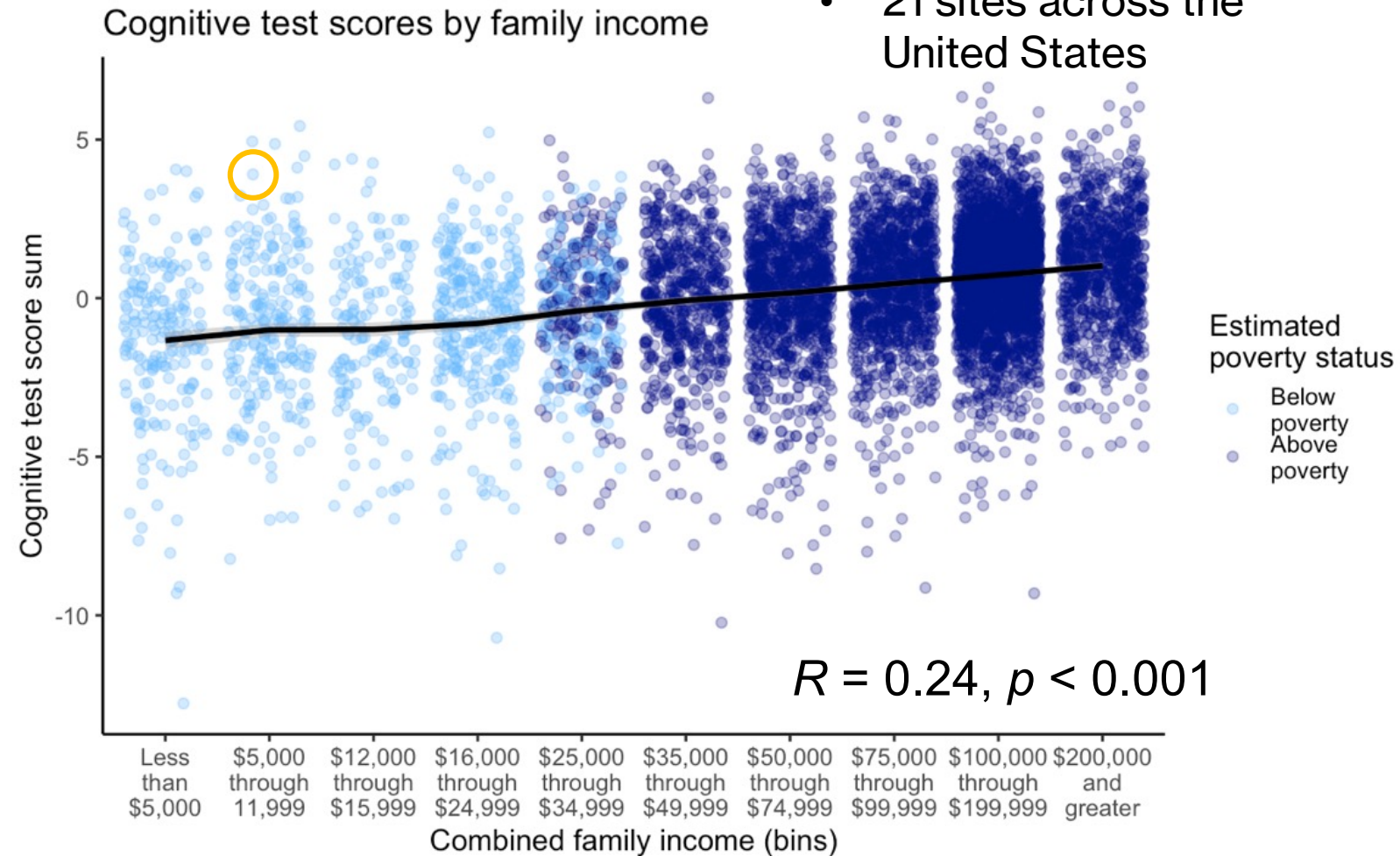
**There is
variability in
test
performance
at every
income level**

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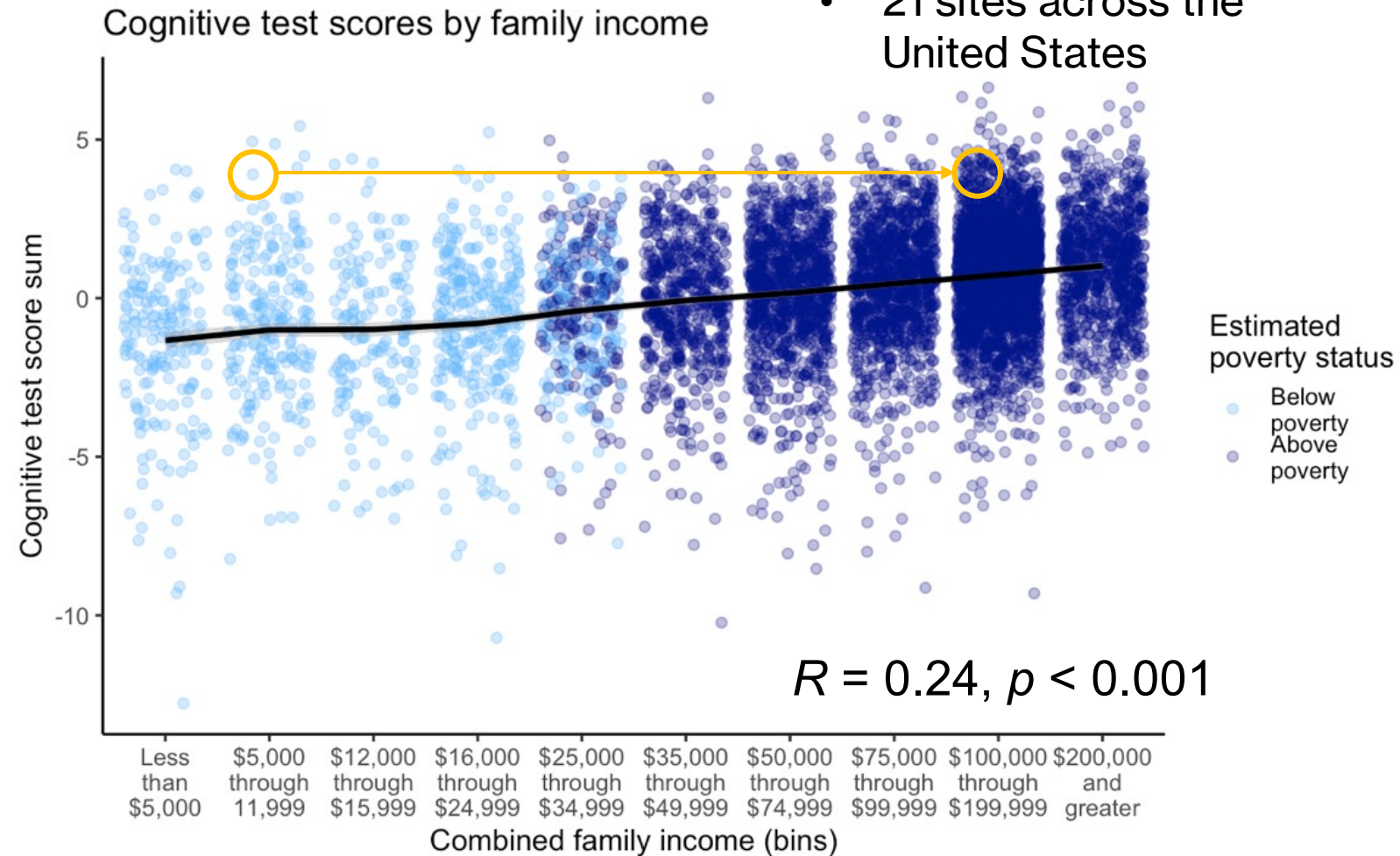
How do children in poverty achieve high performance on cognitive tests?

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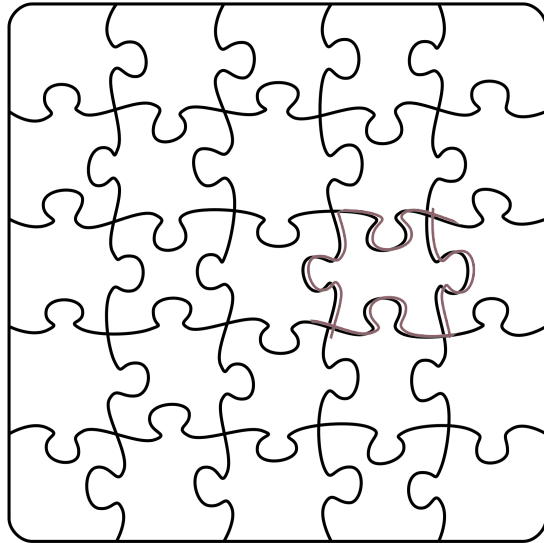
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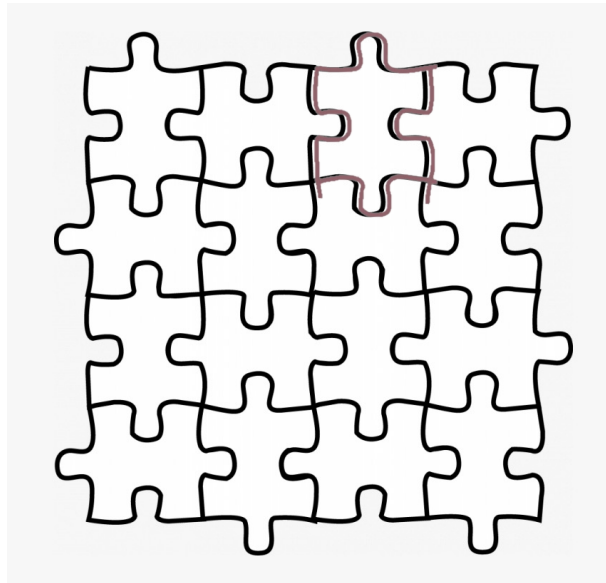
One starting point: the mismatch hypothesis

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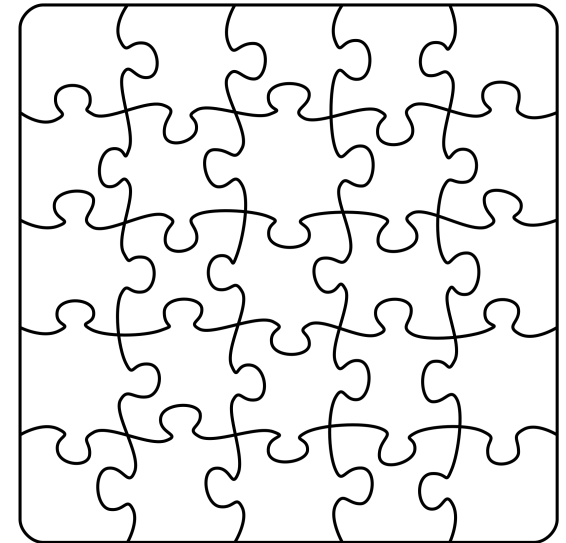
Environment A



Environment B

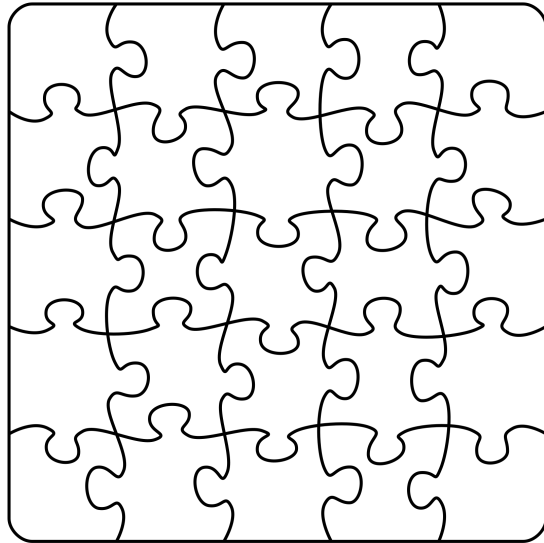


School

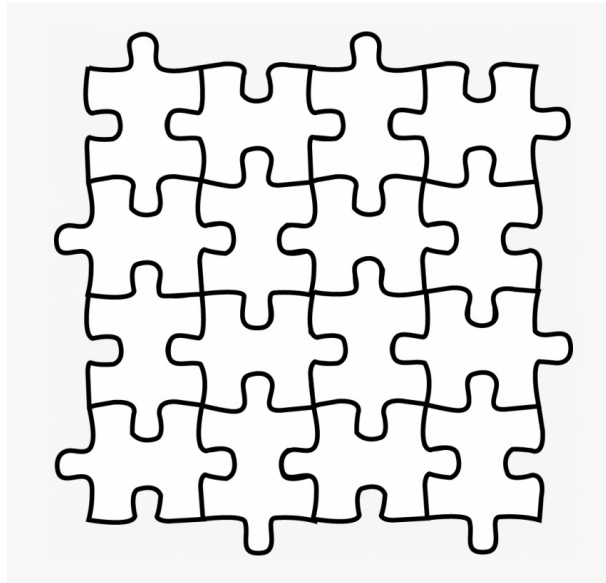


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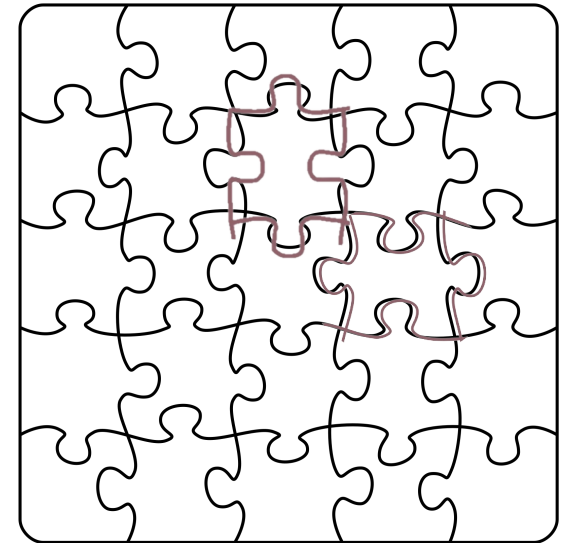
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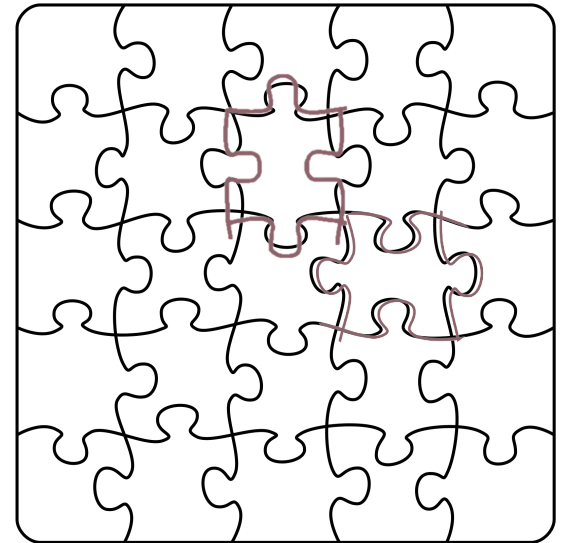
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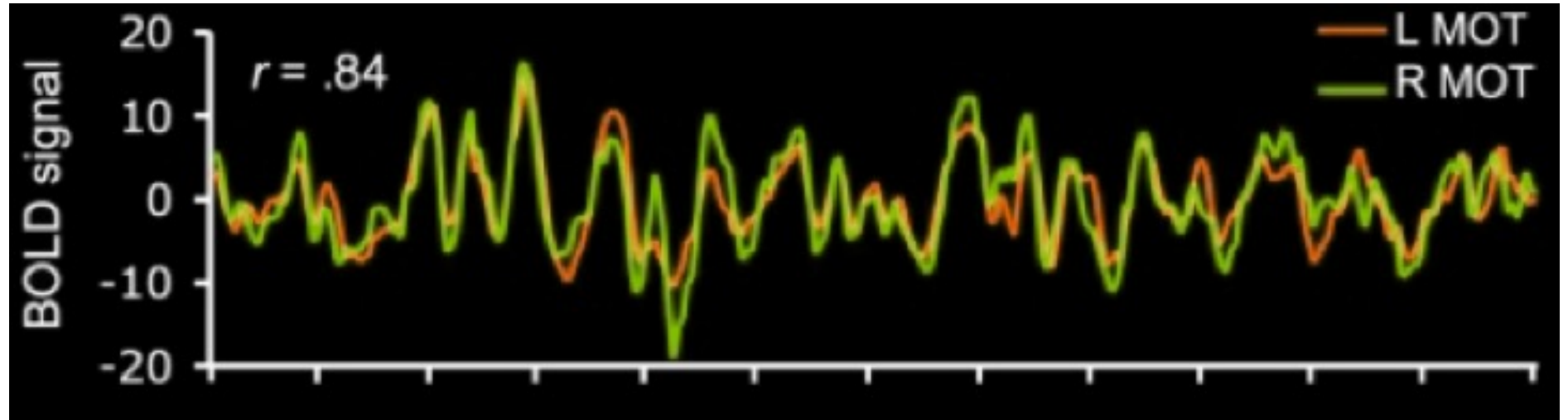
One starting point: the mismatch hypothesis

Resilience = the
ability to adapt to the
new environment

School



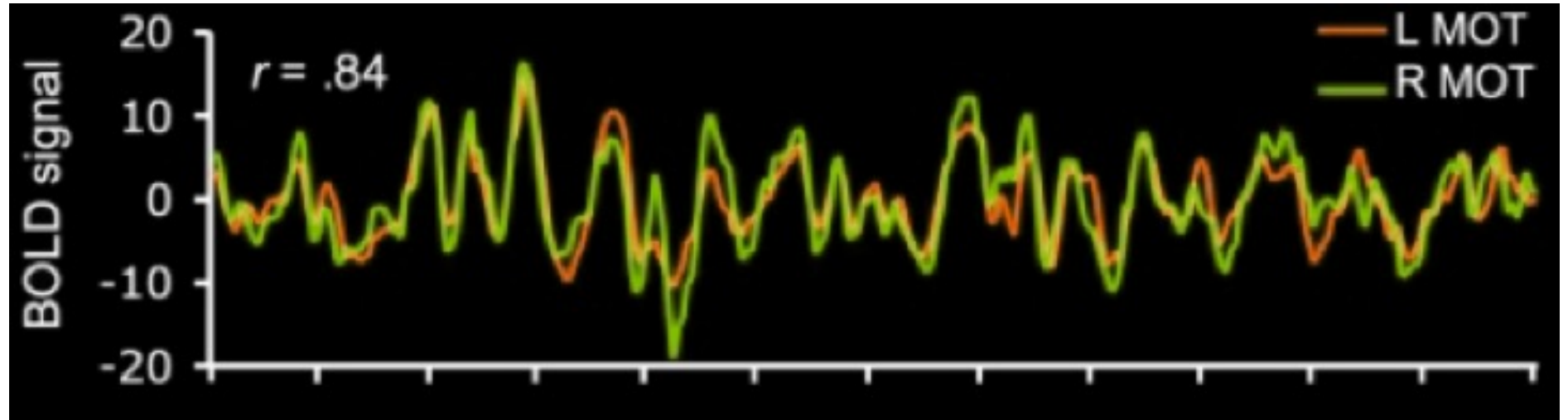
Resting state fMRI: functional connectivity



Intrinsic, spontaneous fluctuations in fMRI BOLD signal

- Regions with strong temporal coupling: high "functional connectivity"
 - Regions with a strong *history of co-activation (cumulative experience)*
 - Form networks of brain regions that are consistent across individuals
 - Reflect prior & ongoing thought patterns (habits of mind)?

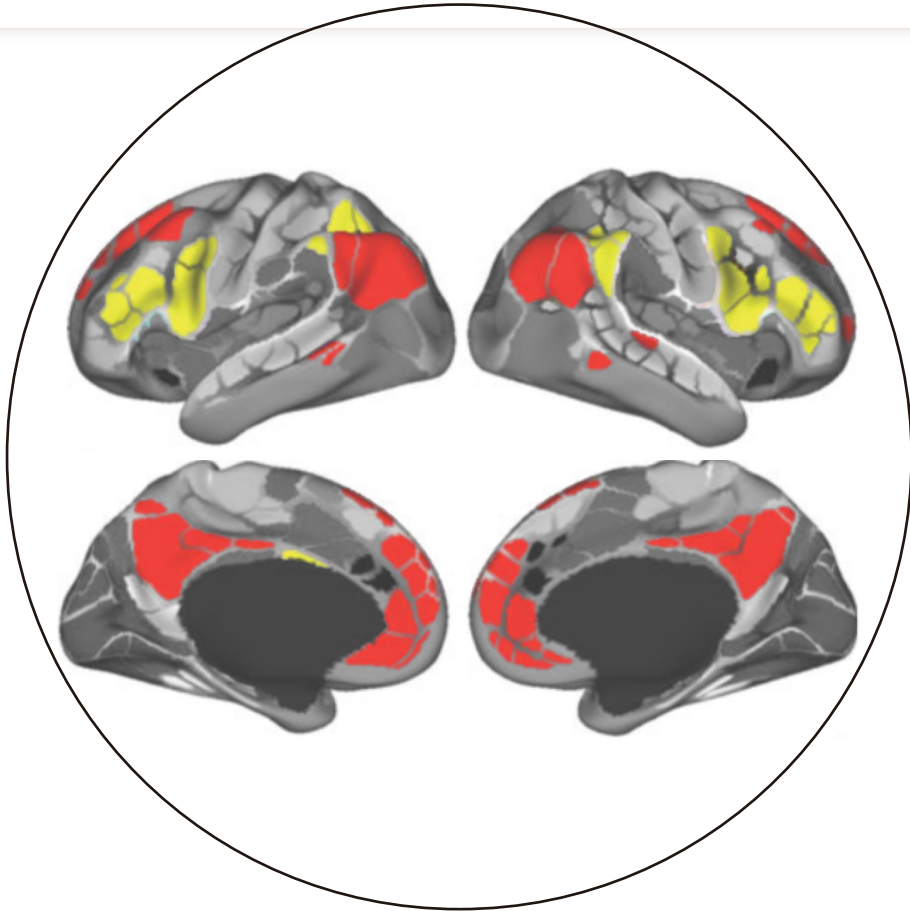
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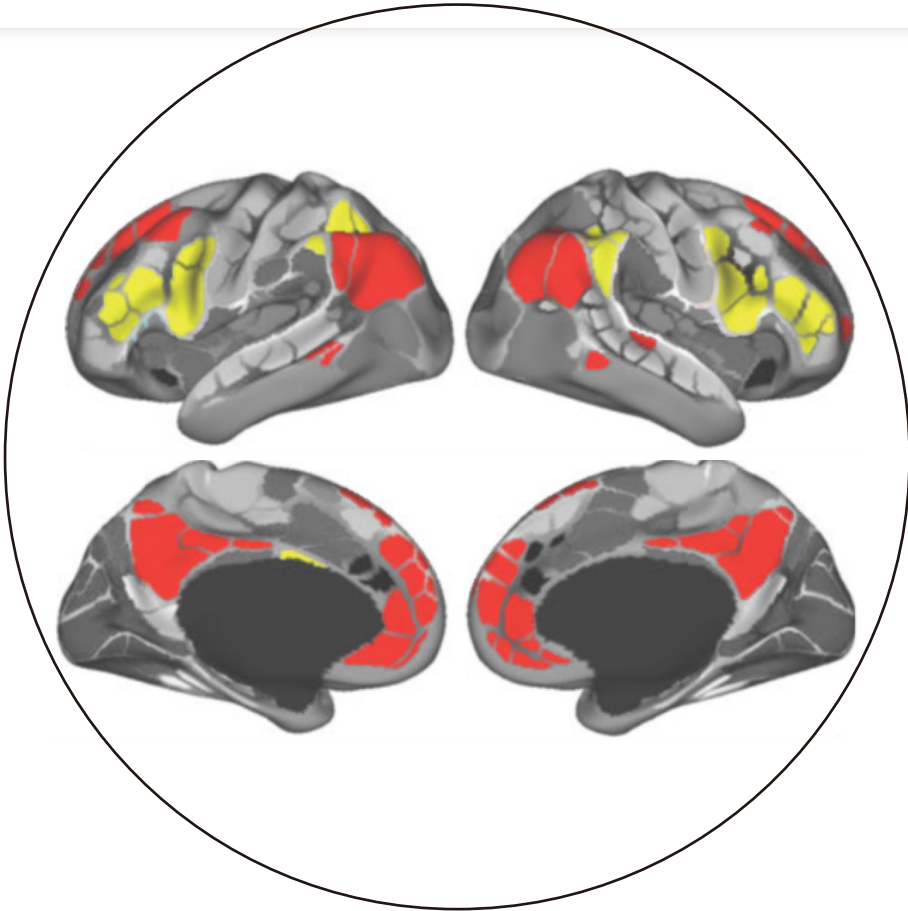
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Less resting state coupling between LFPN and DMN thought to be adaptive



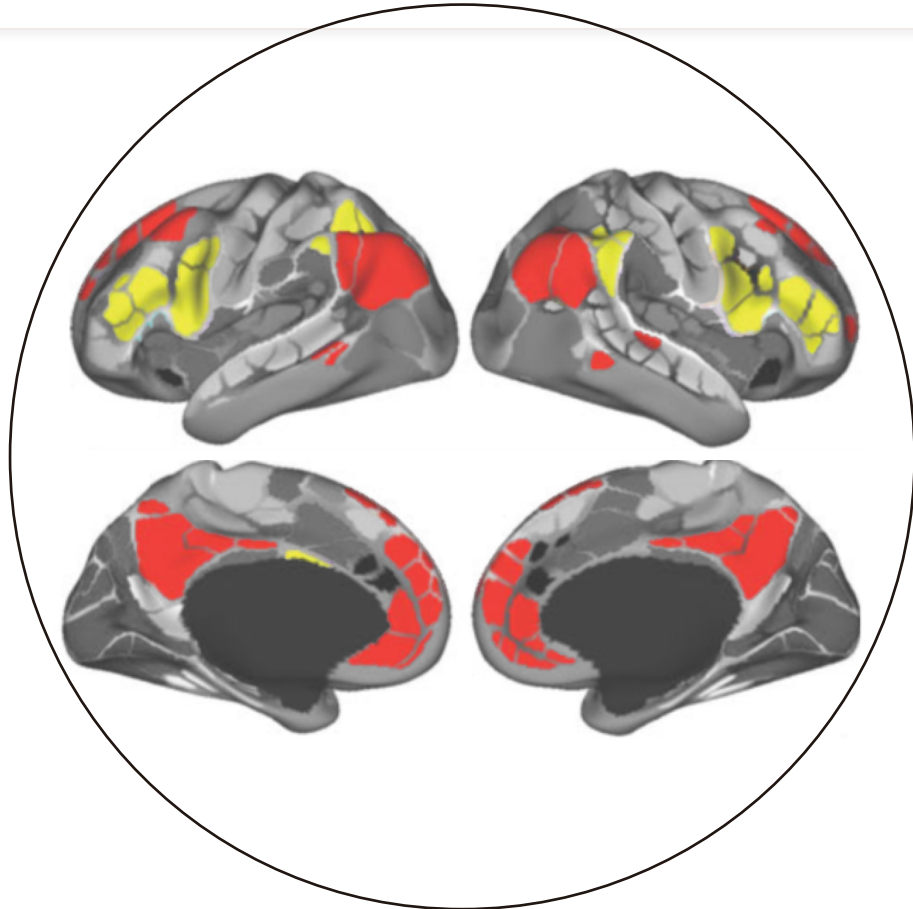
Less resting state coupling between LFPN and DMN thought to be adaptive



LFPN: essential for higher-level cognitive tasks like reasoning

DMN: essential for internally-directed cognition

Less resting state coupling between LFPN and DMN thought to be adaptive



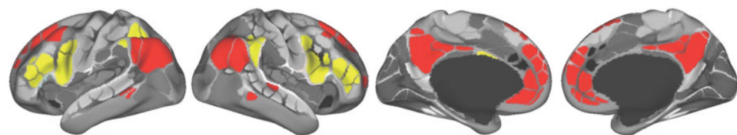
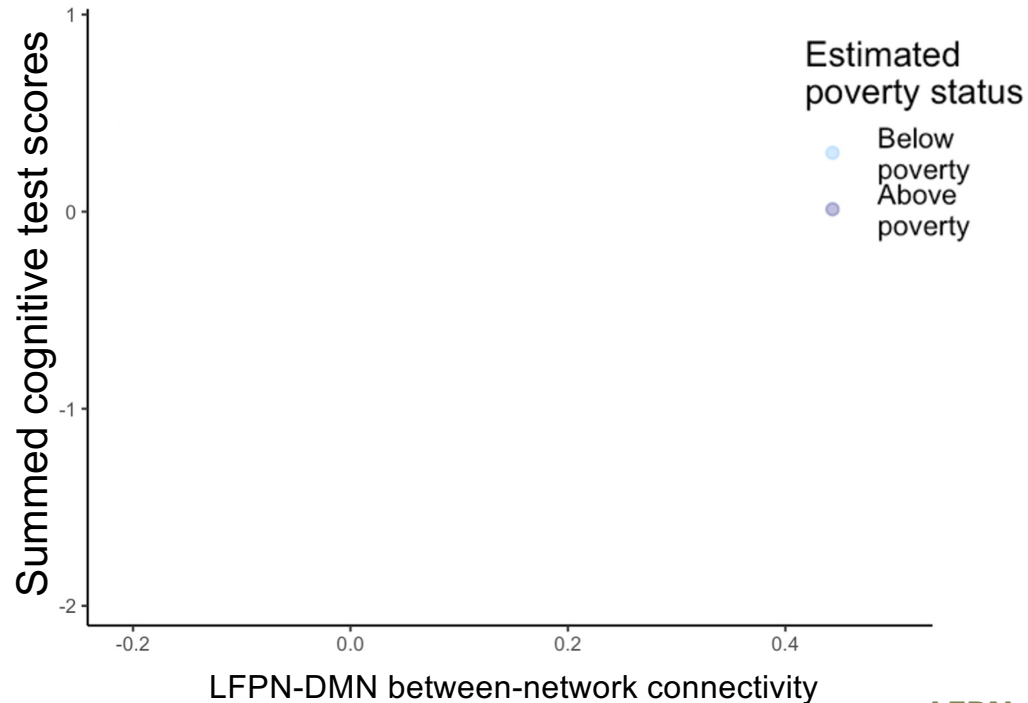
LFPN: essential for higher-level cognitive tasks like reasoning

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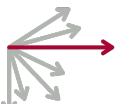
more **LFPN-DMN** segregation linked to better outcomes

LFPN-DMN correlates of test performance

PREDICTED Relation between LFPN-DMN connectivity and test scores



LFPN: essential for higher-level cognitive tasks like reasoning | **DMN**: essential for internally-directed cognition

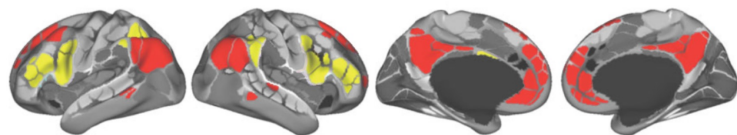
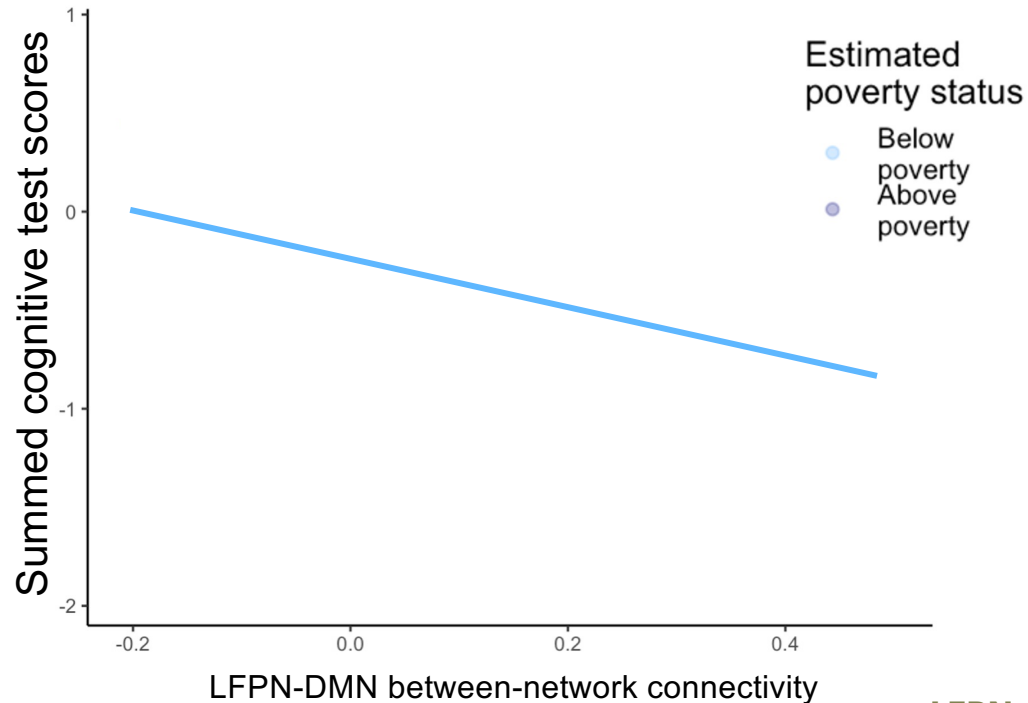


AS PREDICTED

Ellwood-Lowe, Whitfield-Gabrieli, & Bunge, 2021, *Nature Communications*

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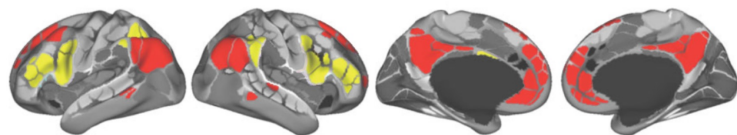
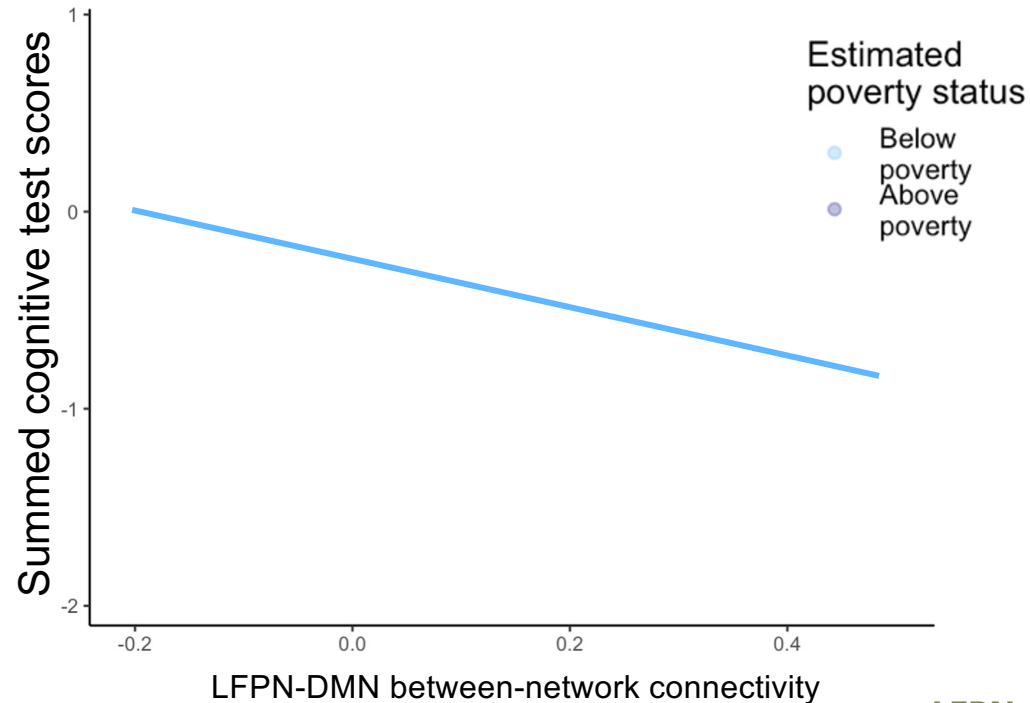
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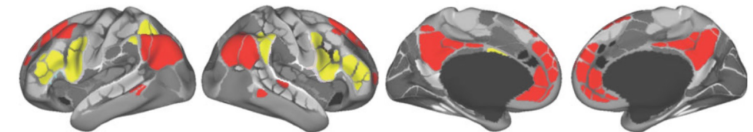
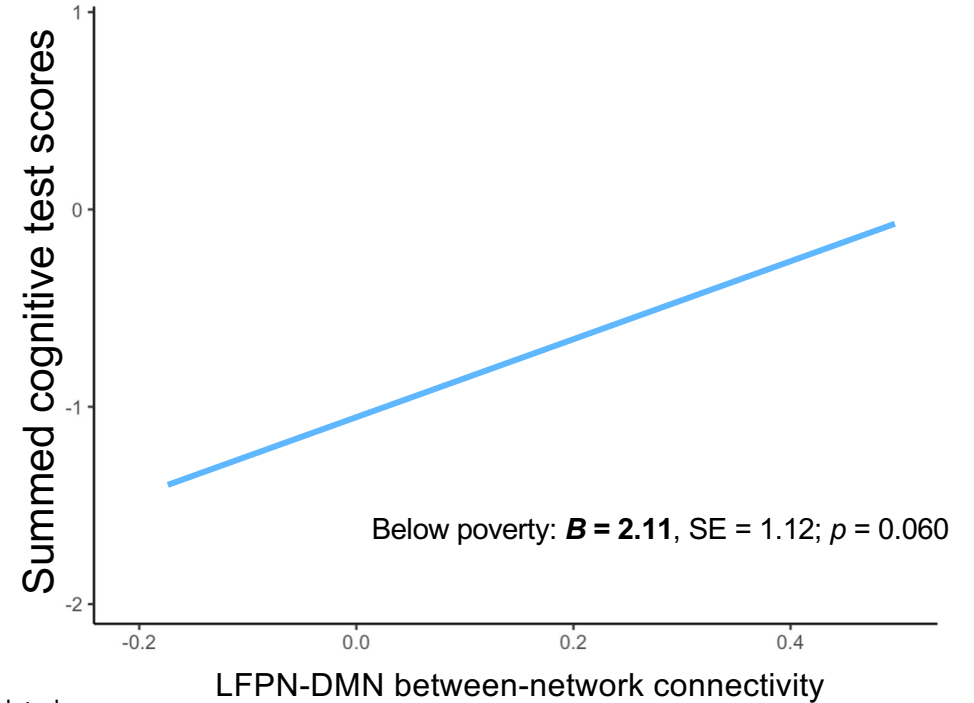
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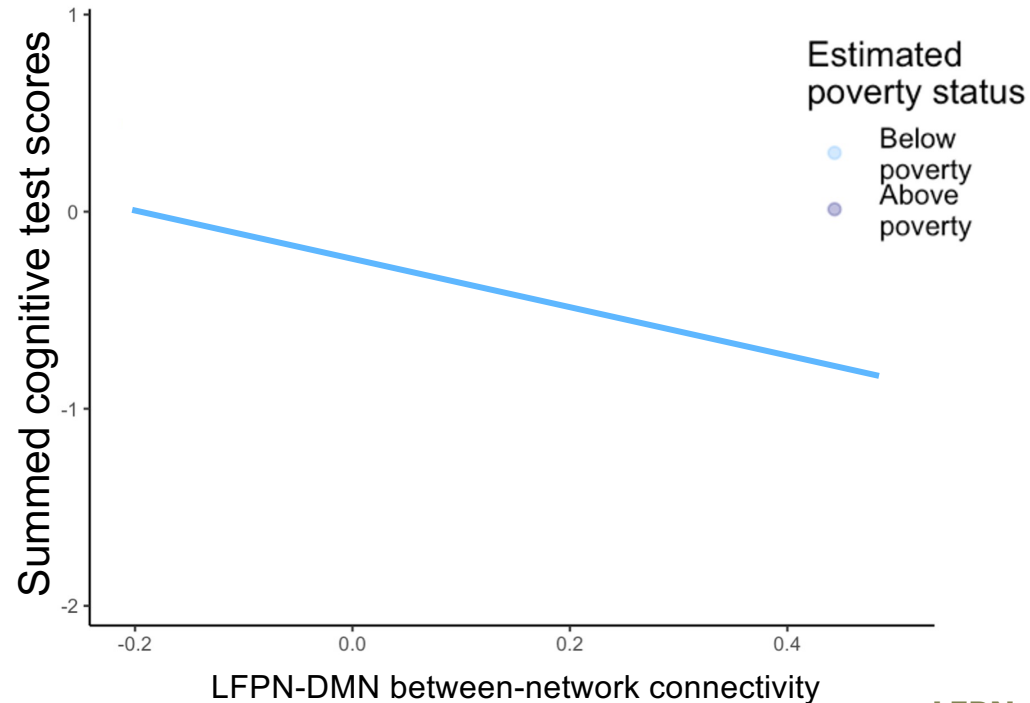
ACTUAL Relation between LFPN-DMN connectivity and test scores



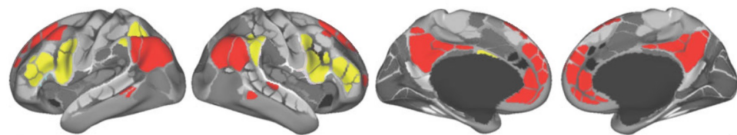
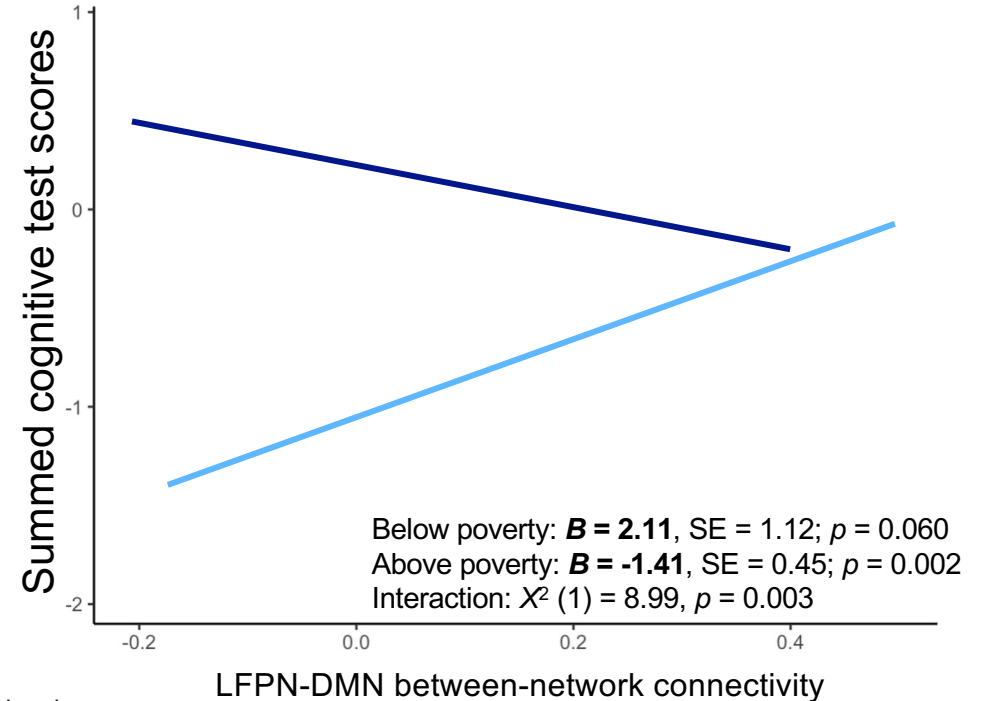
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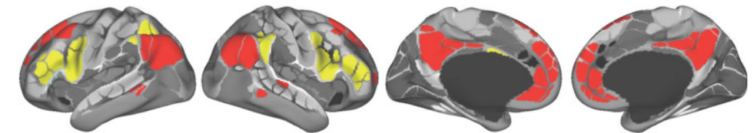
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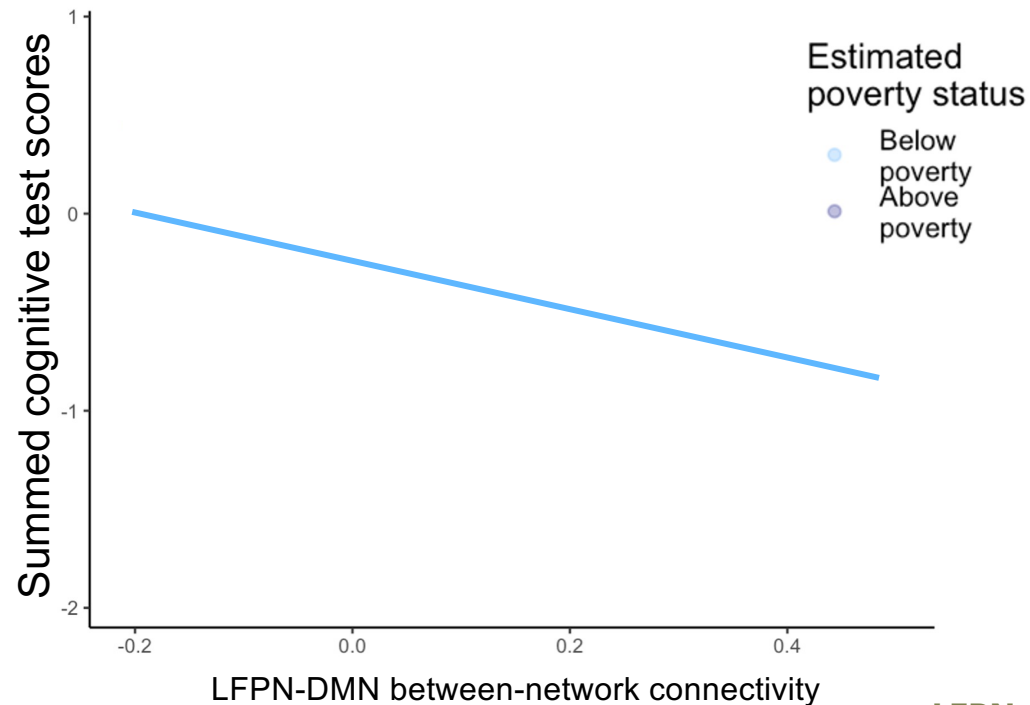
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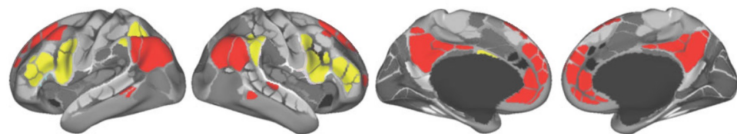
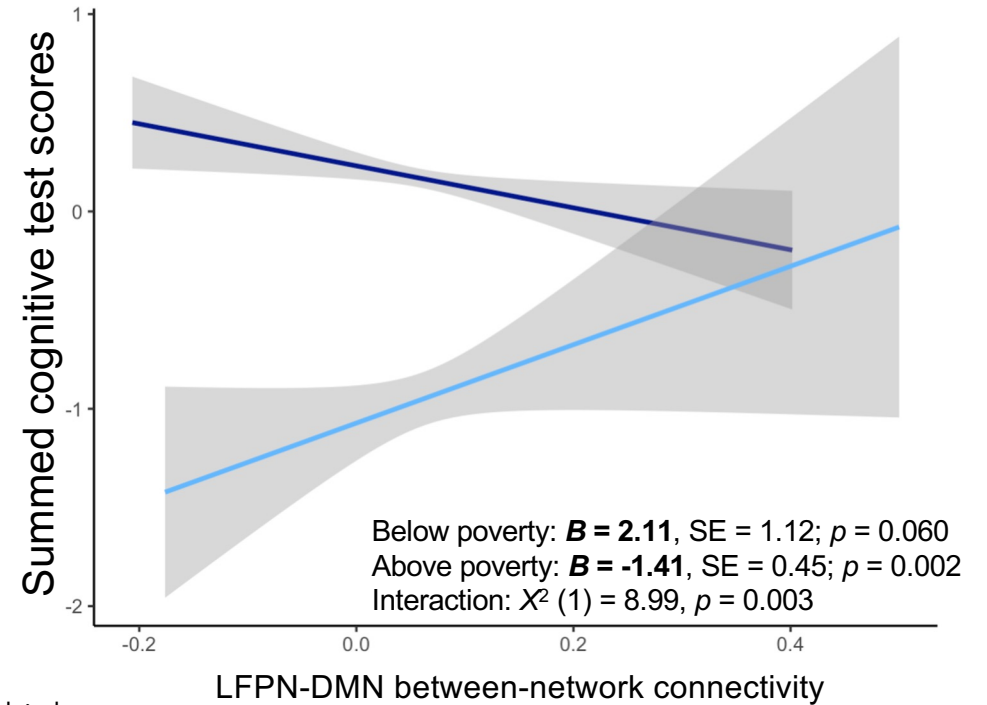
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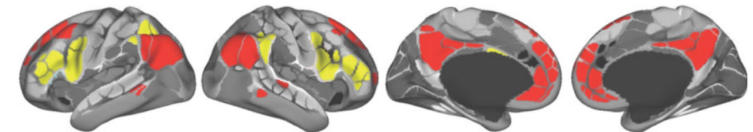
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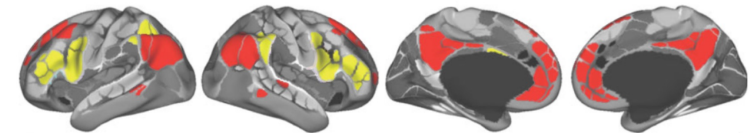
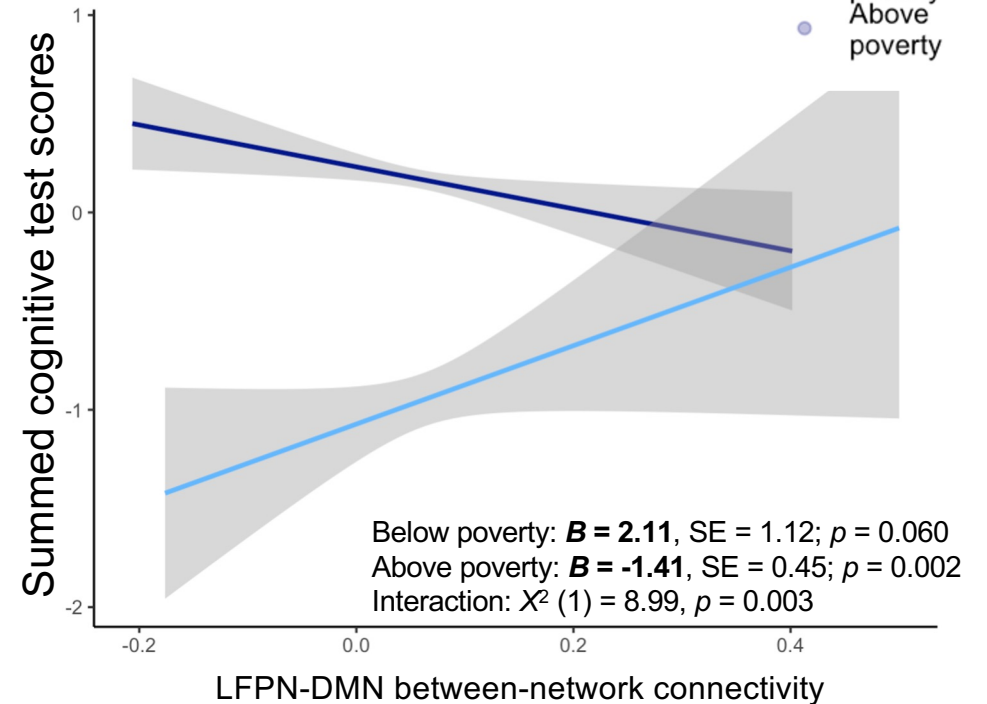
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ACTUAL

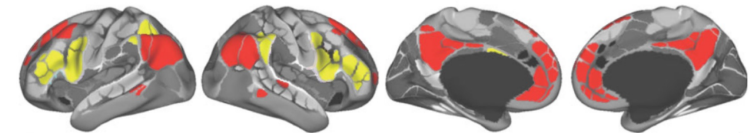
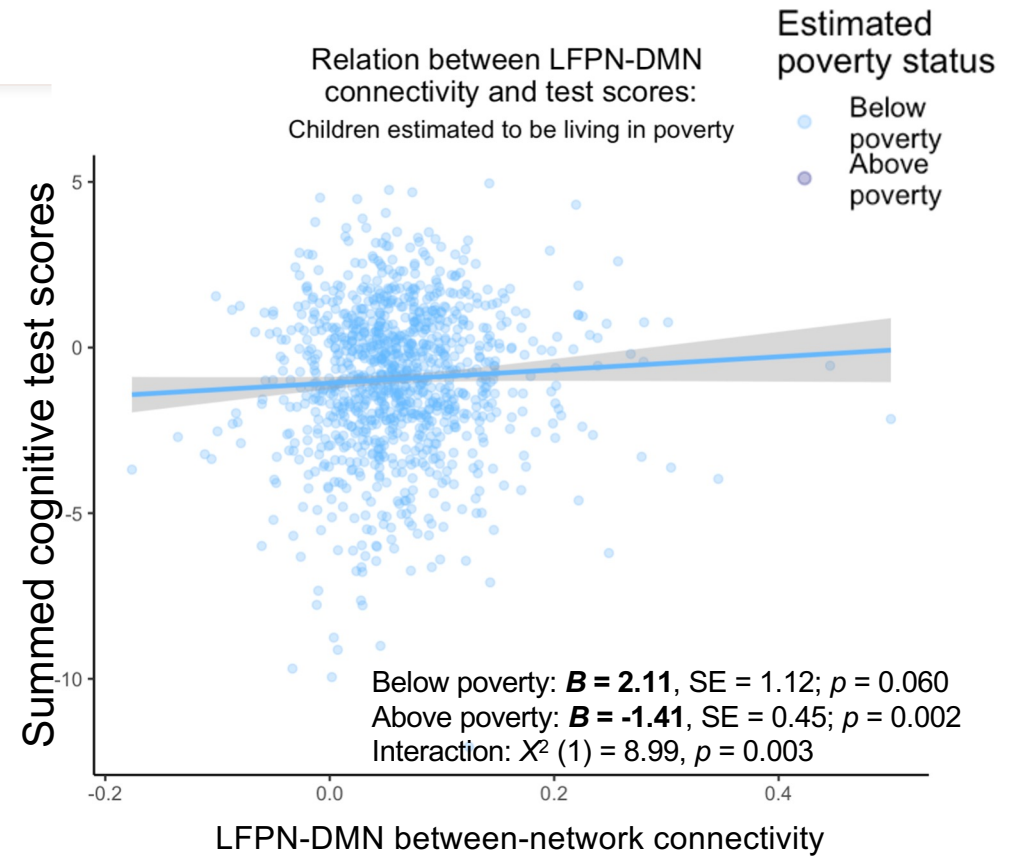
Relation between LFPN-DMN connectivity and test scores

Estimated poverty status

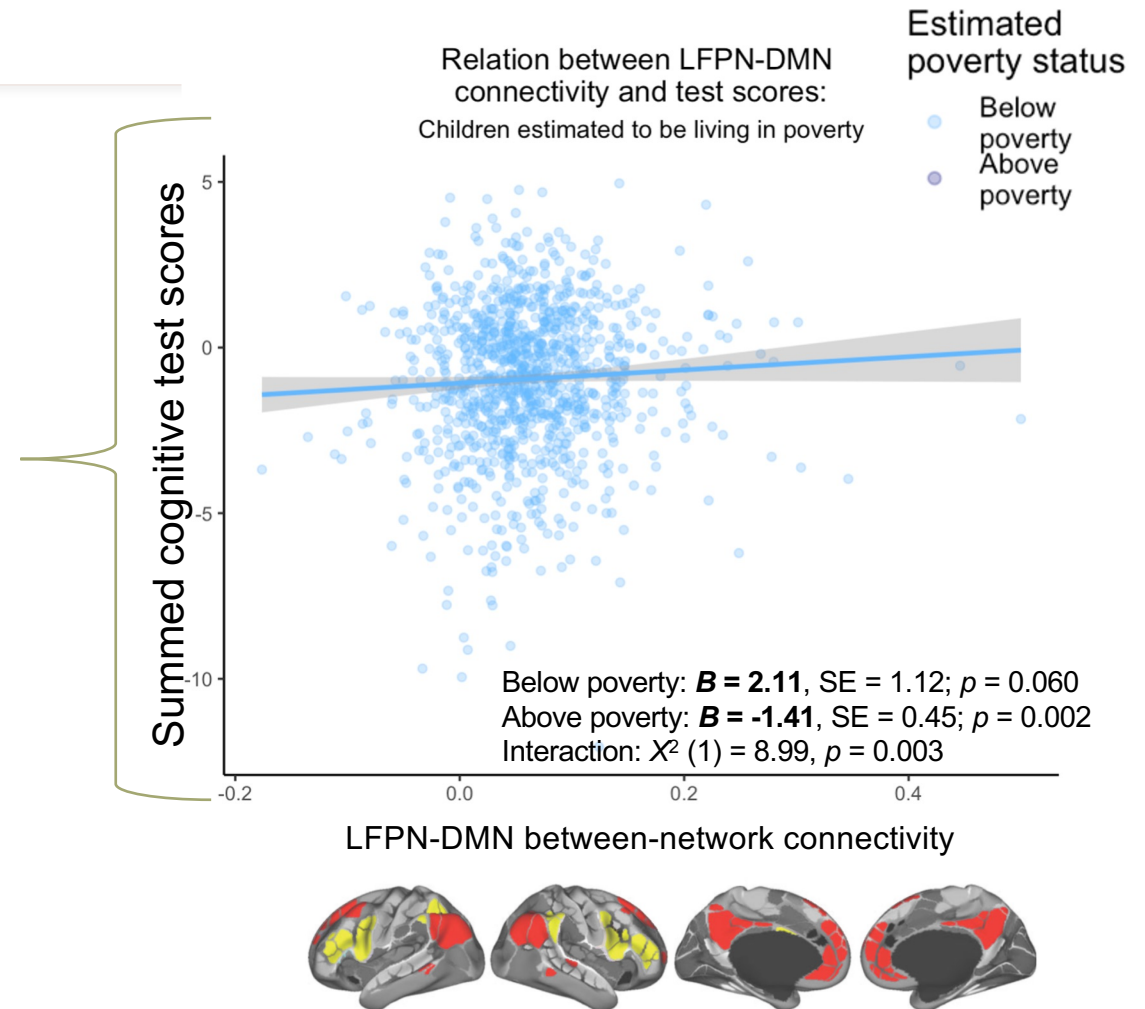
Below poverty
Above poverty



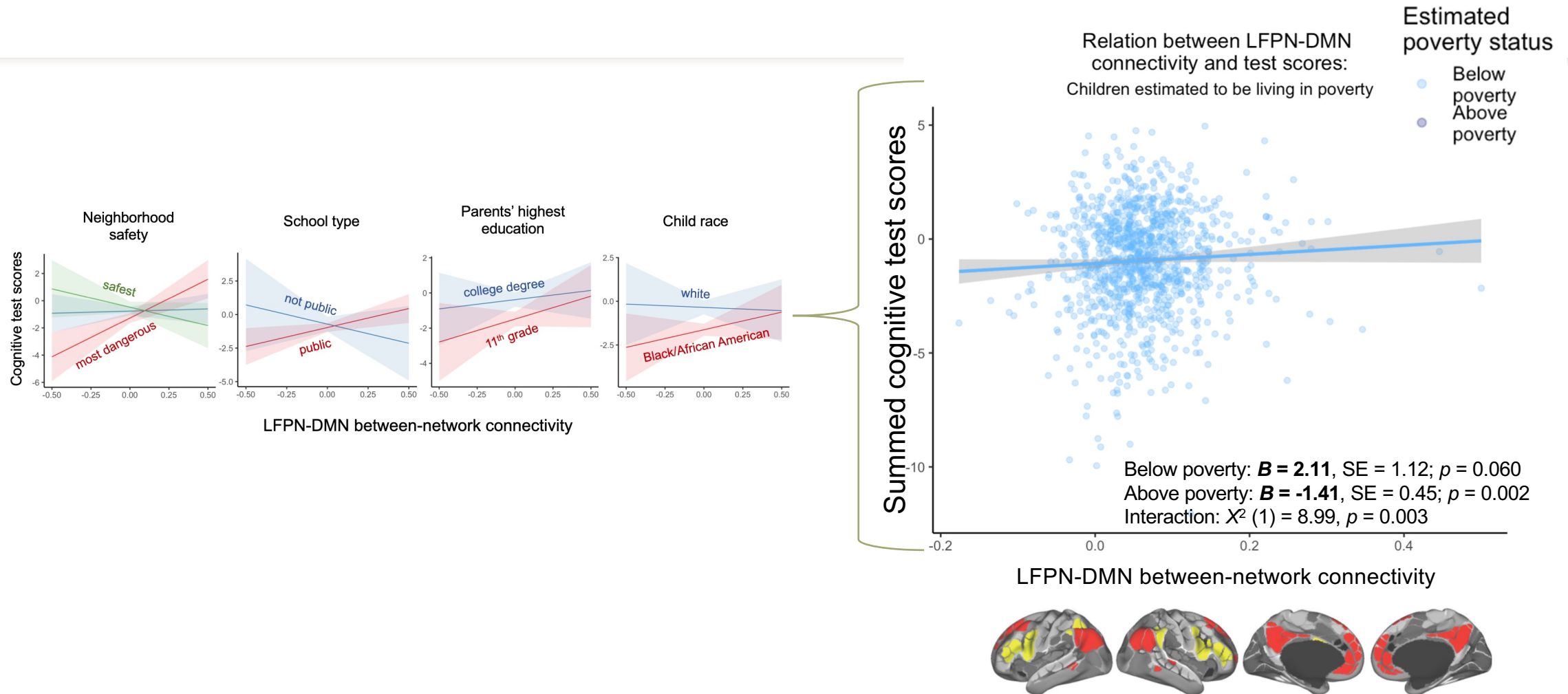
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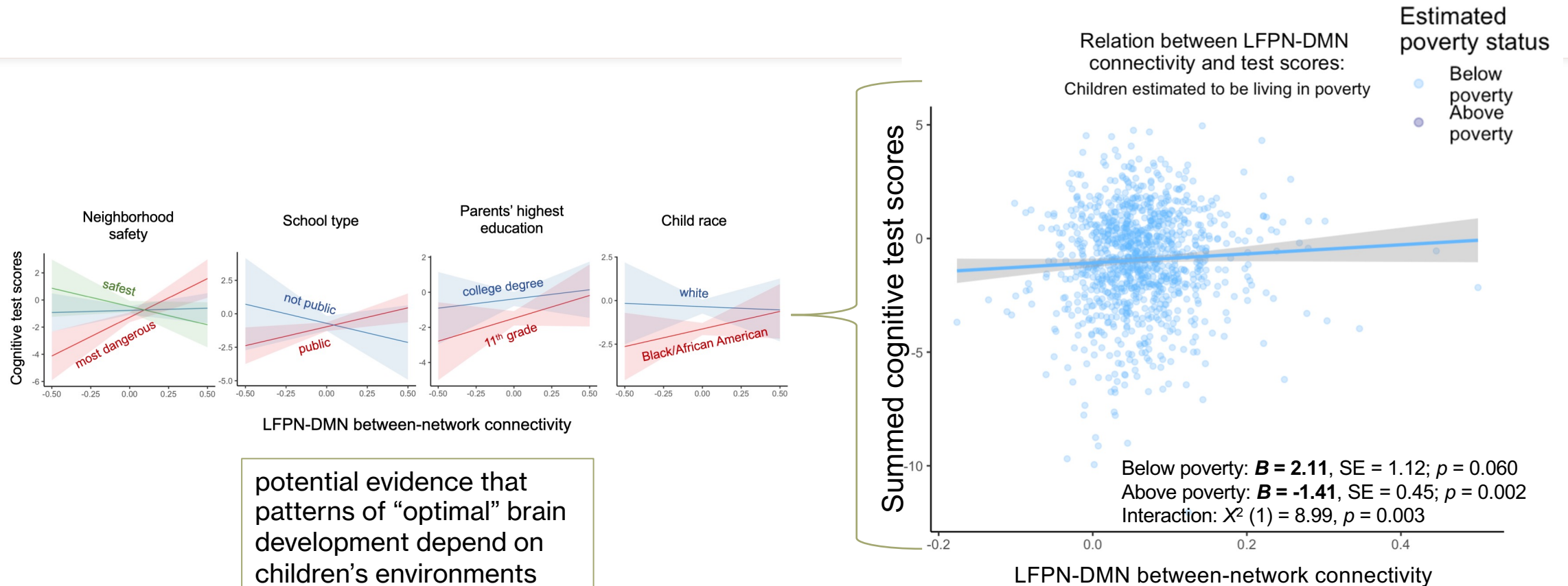
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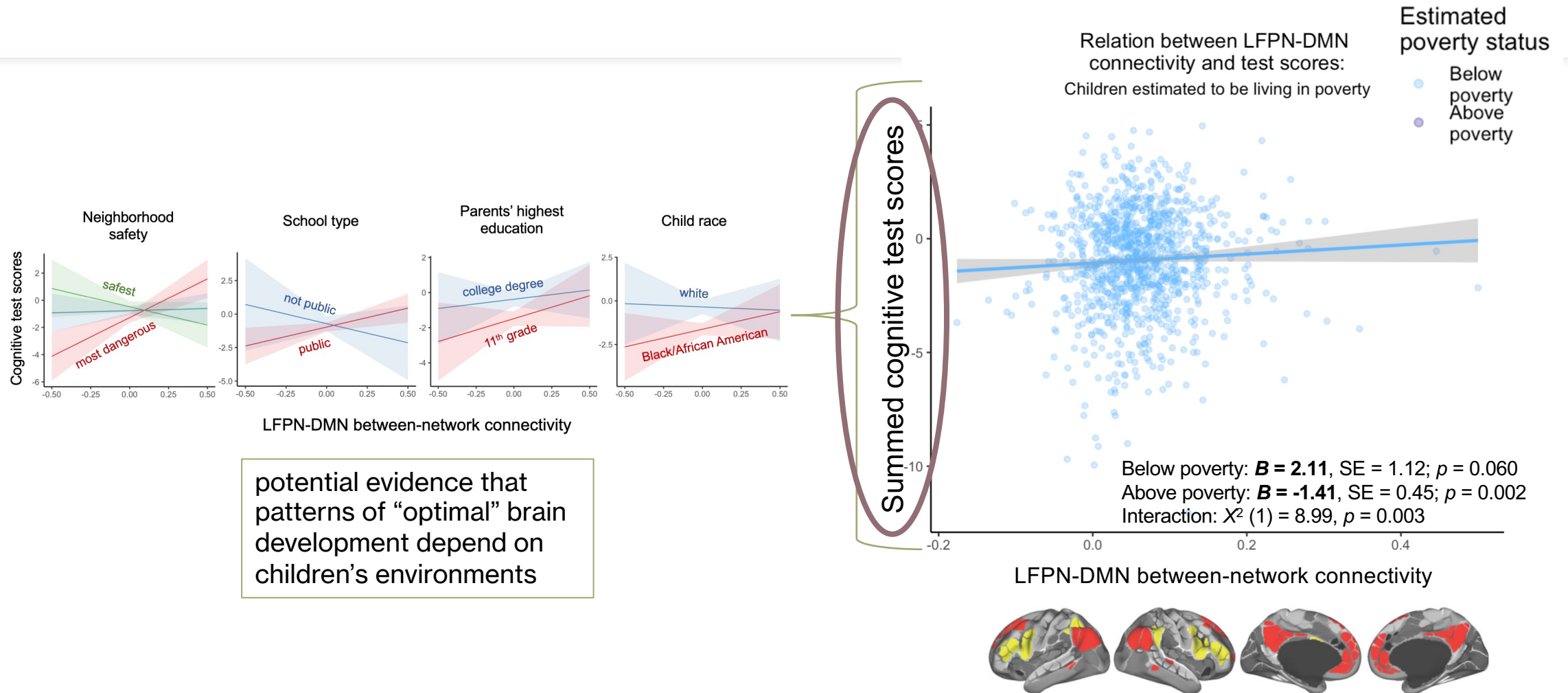
LFPN-DMN correlates of test performance



LFPN-DMN correlates of test performance



LFPN-DMN correlates of test performance



Exploring LFPN- DMN correlates of performance in the “real world” over time



Carolyn Irving



Silvia Bunge

**Exploring LFPN-
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**Ecologically-
valid measures:**

- Grades in school
- Attention problems



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Longitudinal sampling:

- Ages 9-10
- Ages 10-11
- Ages 11-12



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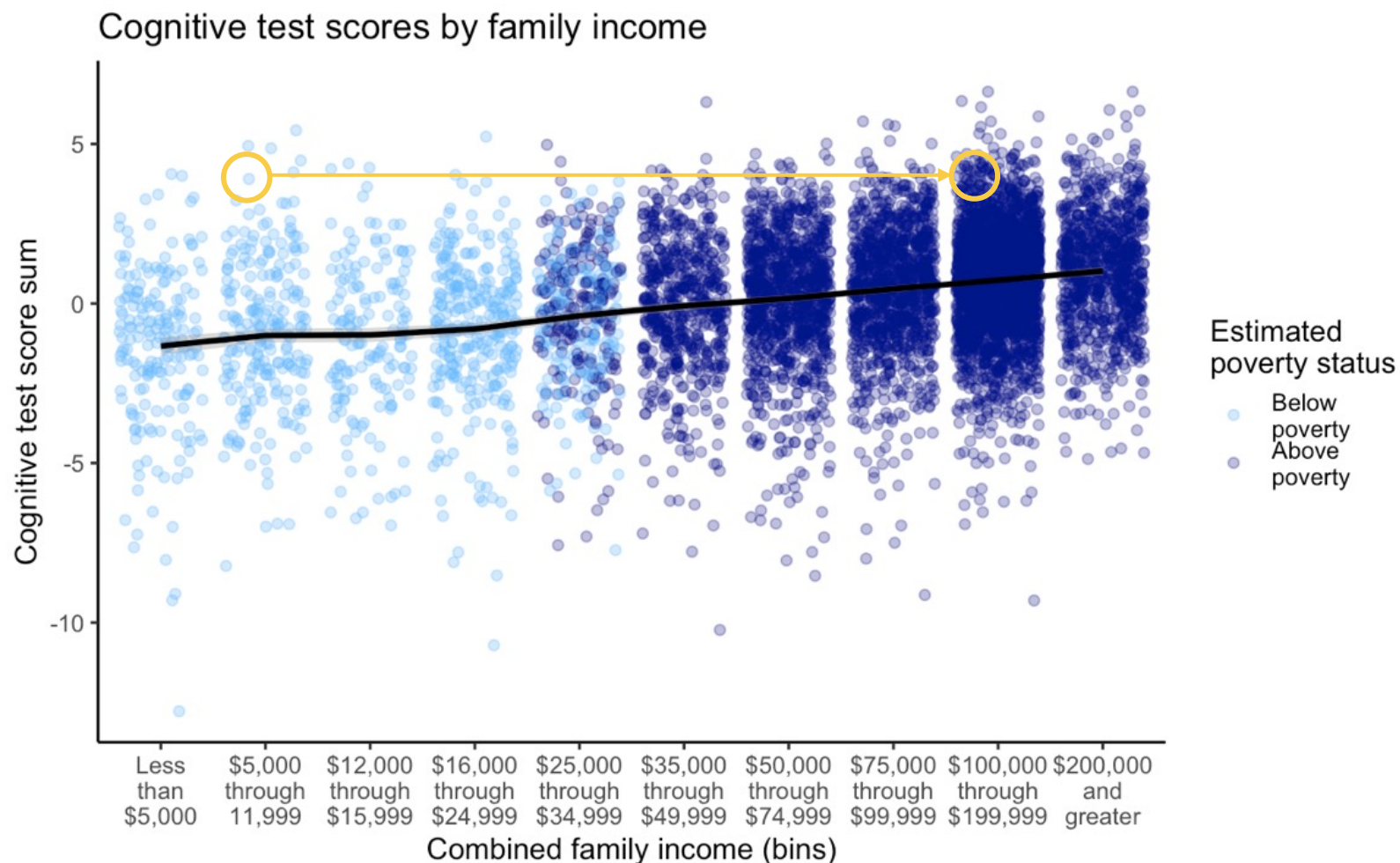
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evidence that in our sample, this is a robust and meaningful dissociation

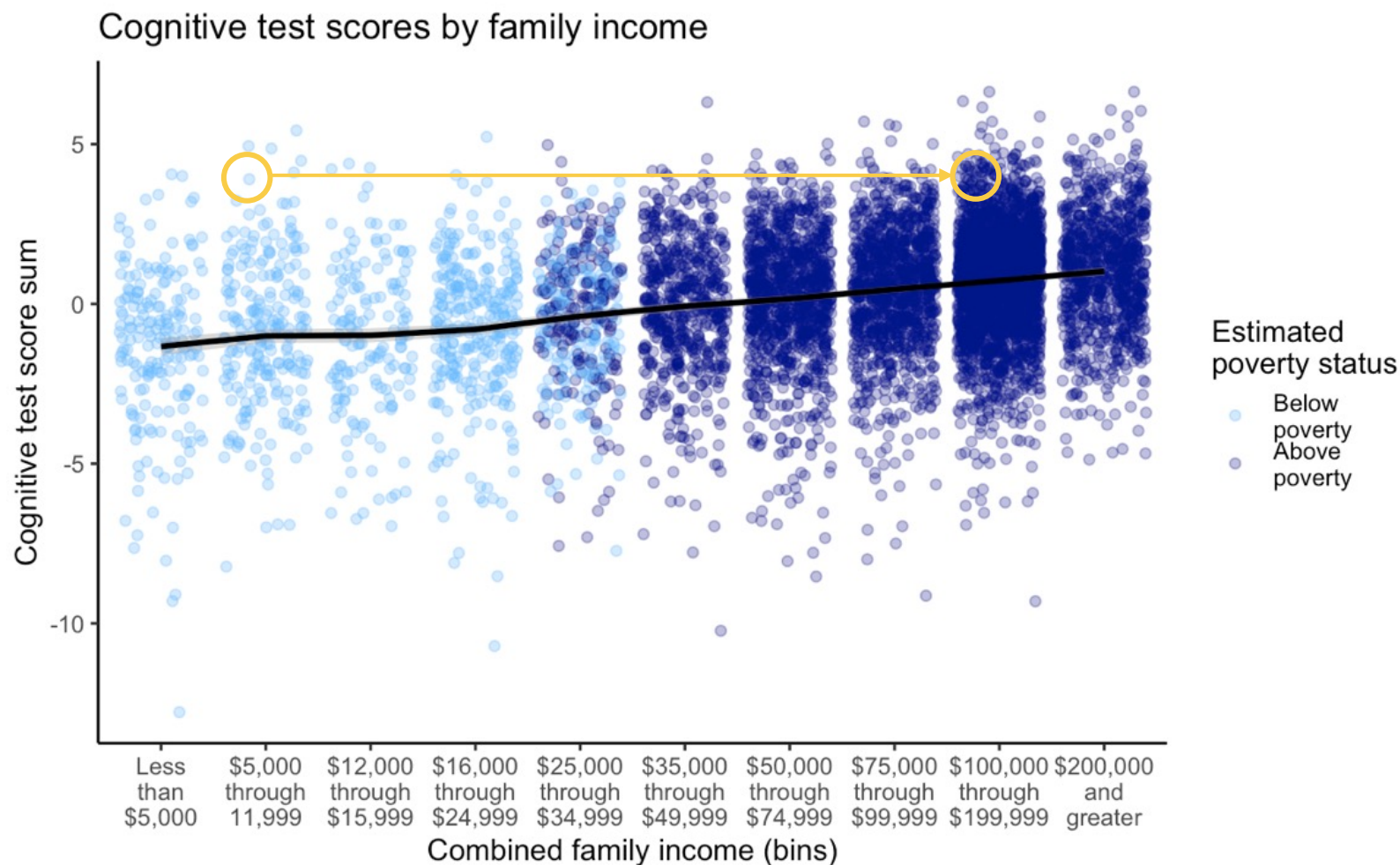
Children in poverty might rely on different mechanisms to perform well



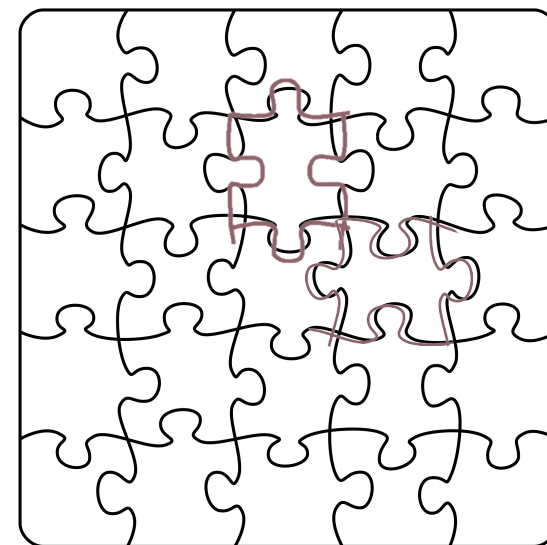
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School

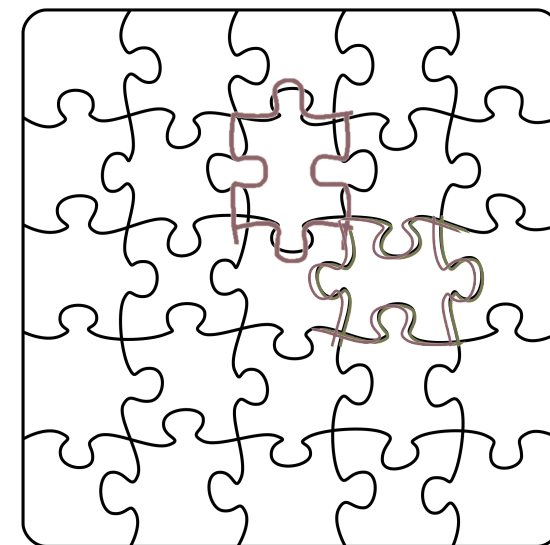


e.g., Frankenhuys et al., 2020

Children in poverty might rely on different mechanisms to perform well



School



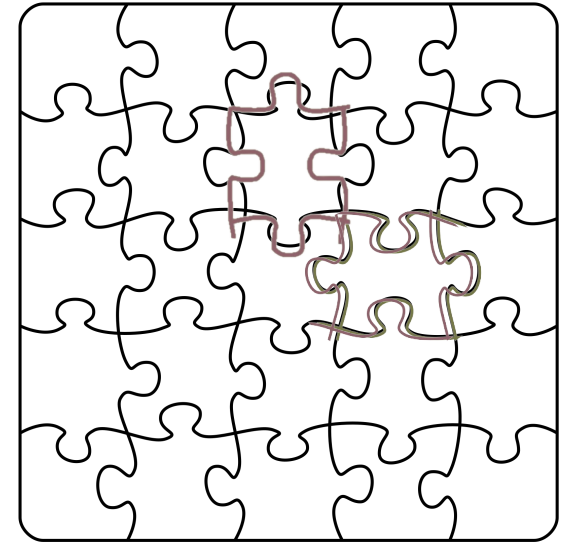
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Children in poverty might rely on different mechanisms to perform well

LFPN and DMN coactivate during:

- Drawing on past experiences and planning for the future
- Directed mind-wandering and meditation
- Creative thinking

School



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HEALTHCARE & MEDICINE

11 / UPDATED 9 YEARS AGO

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**The brain adapts
meaningfully to
different
constraints**

T H A N K Y O U !

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