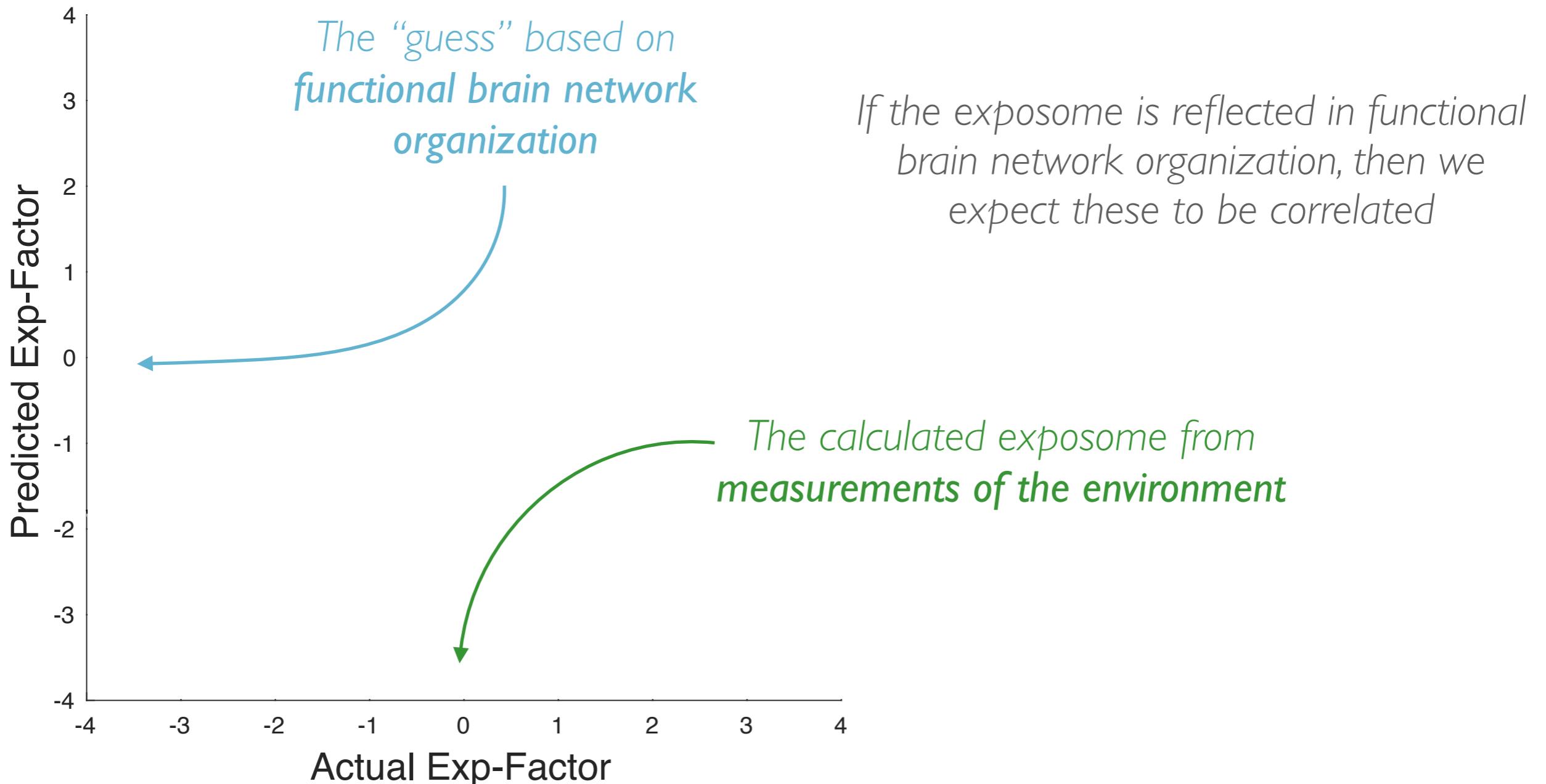
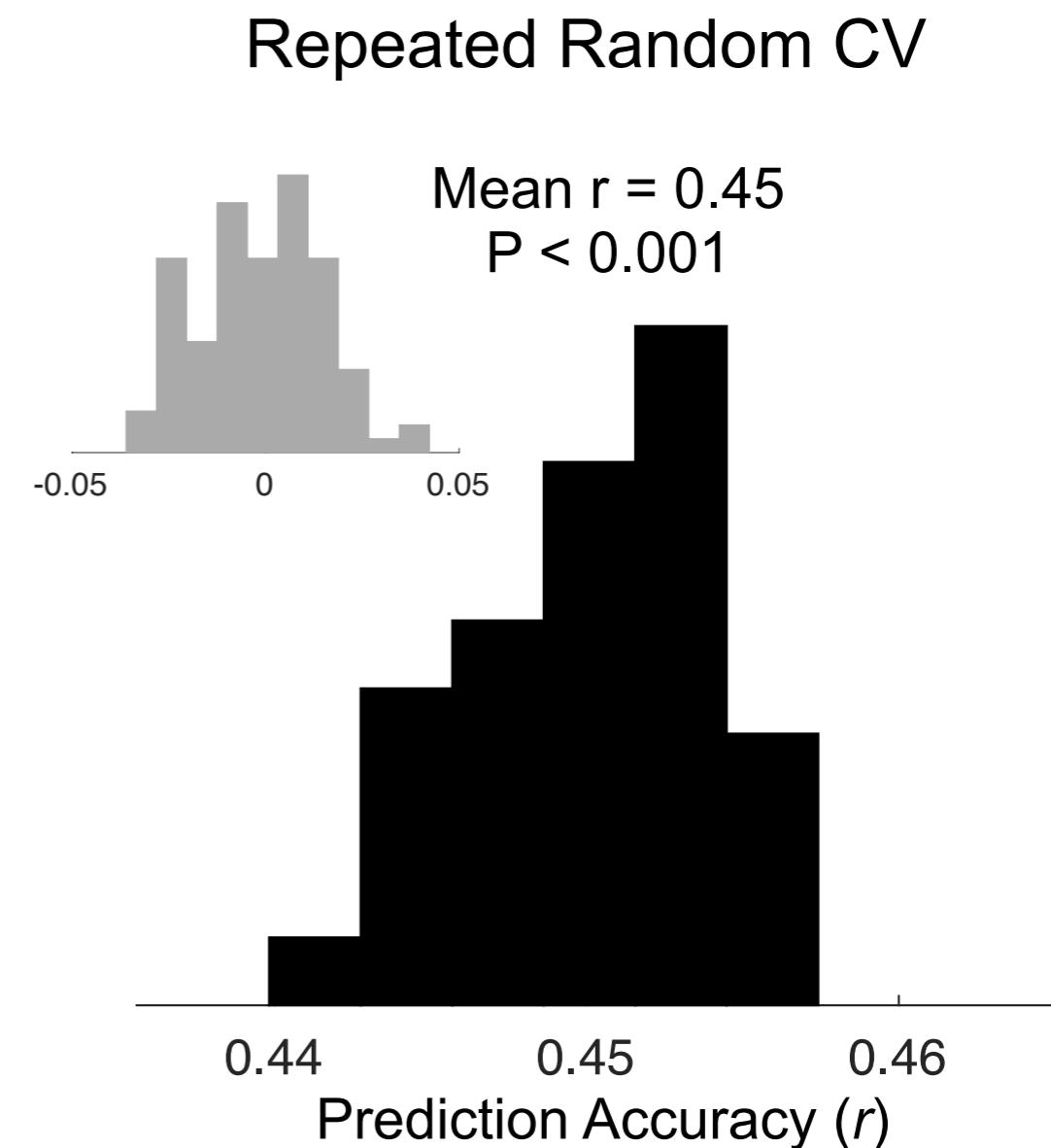
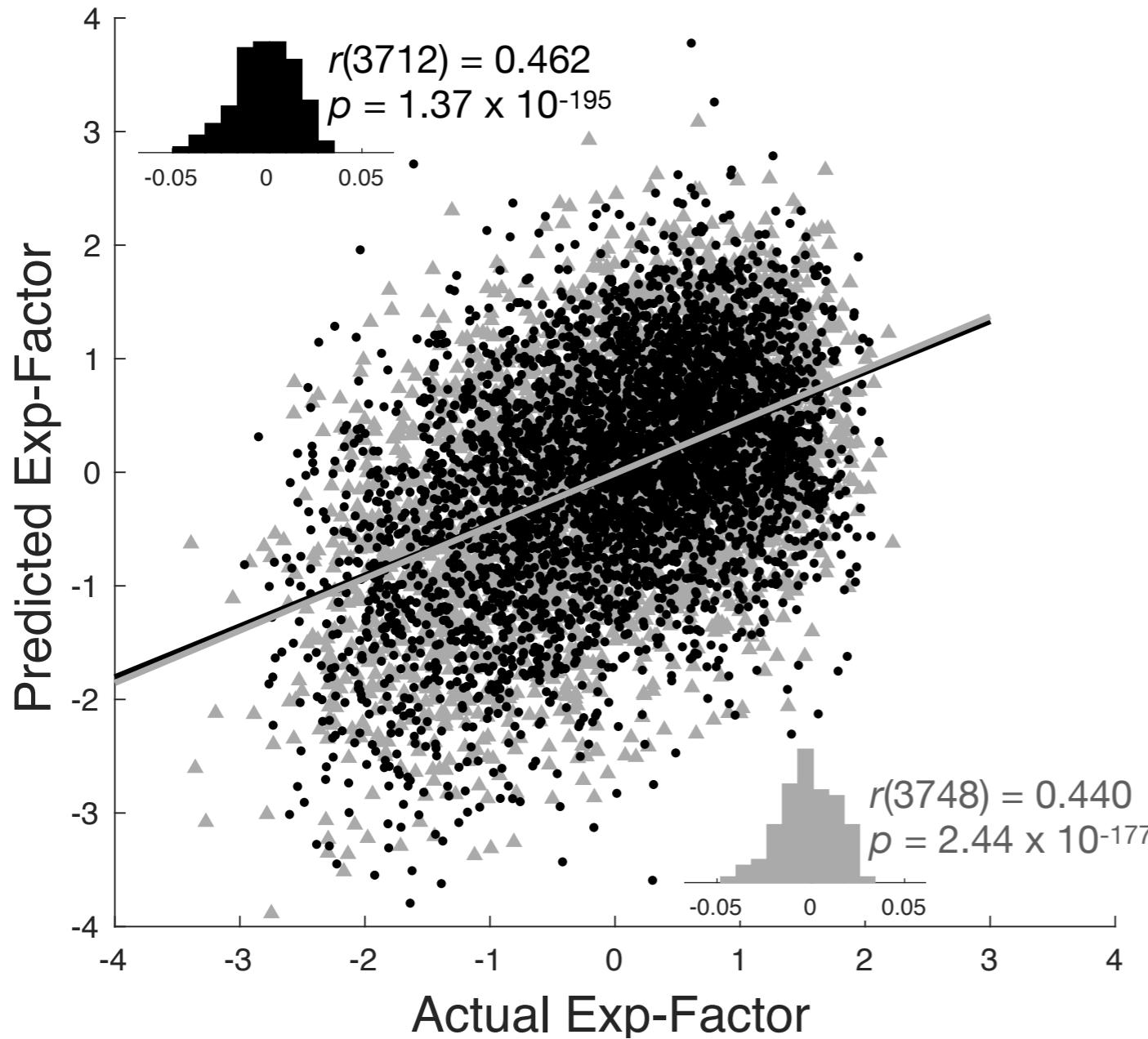


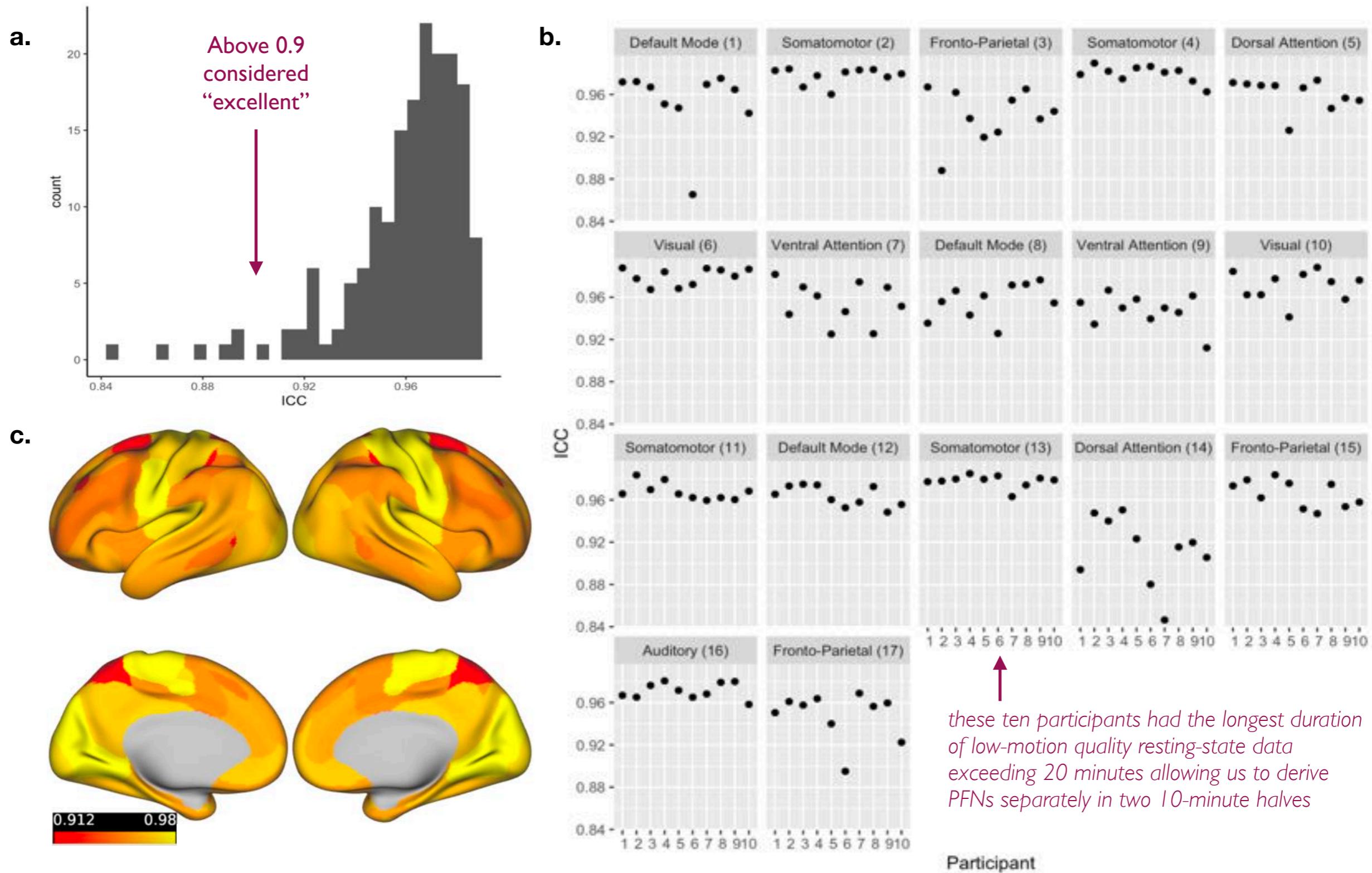
Exp-Factor is reflected in childrens' functional brain organization



Exp-Factor is reflected in childrens' functional brain organization

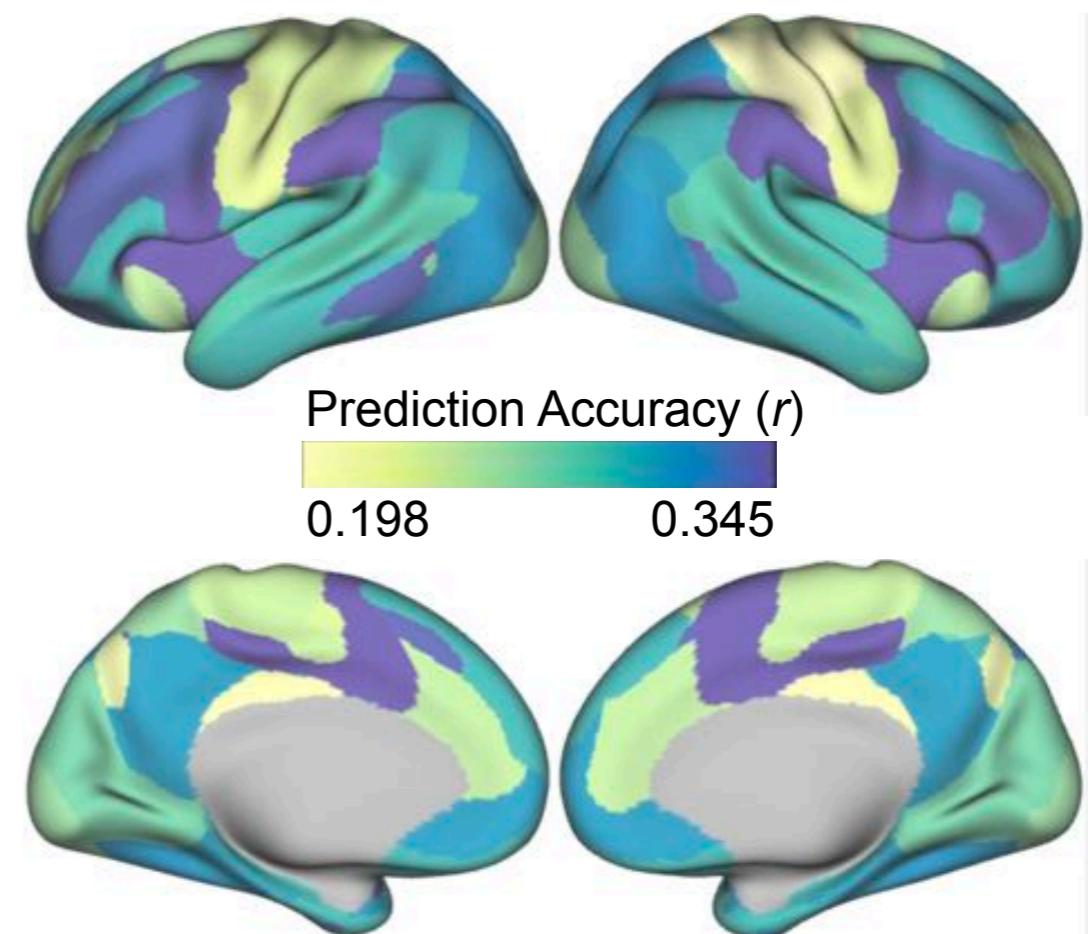
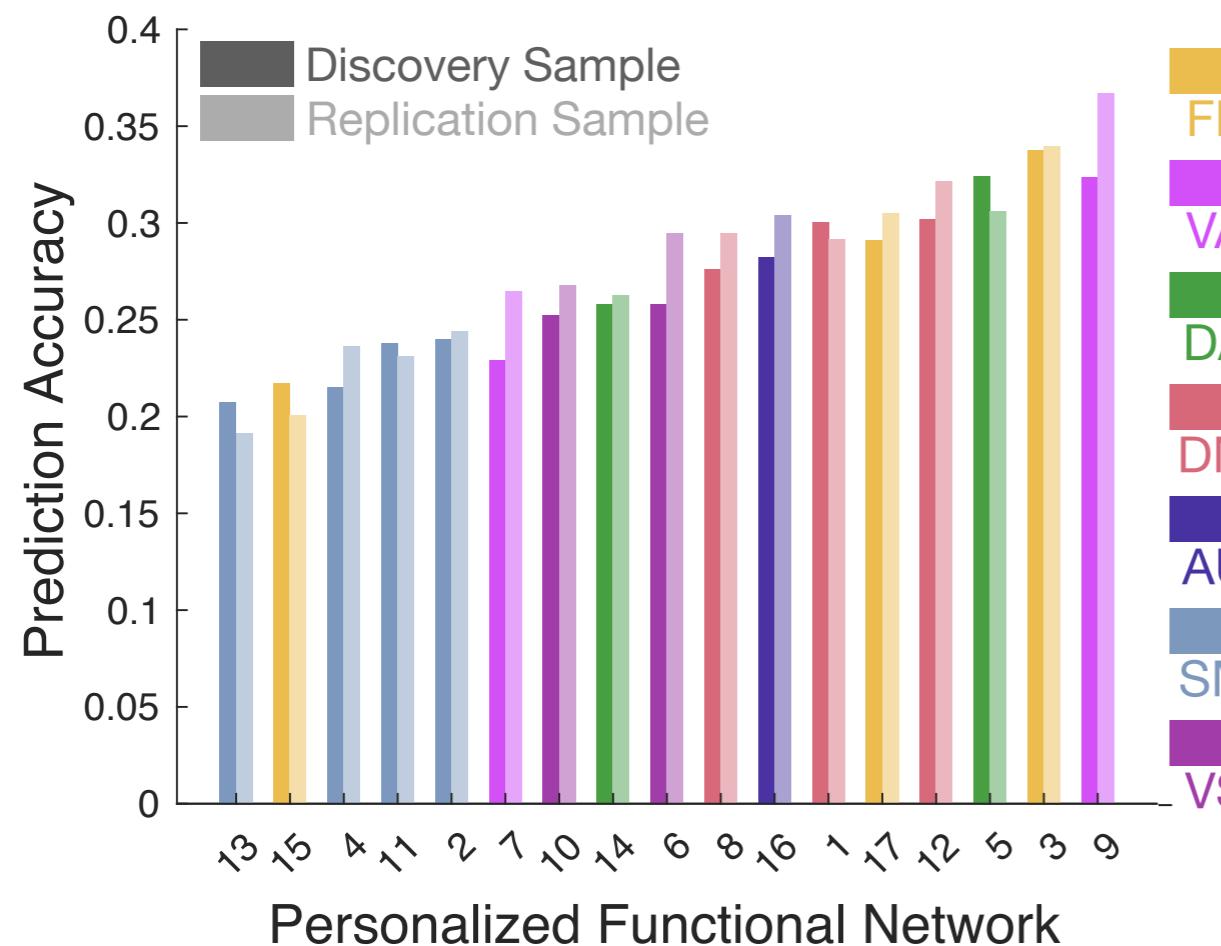


Test-Retest Reliability of PFNs

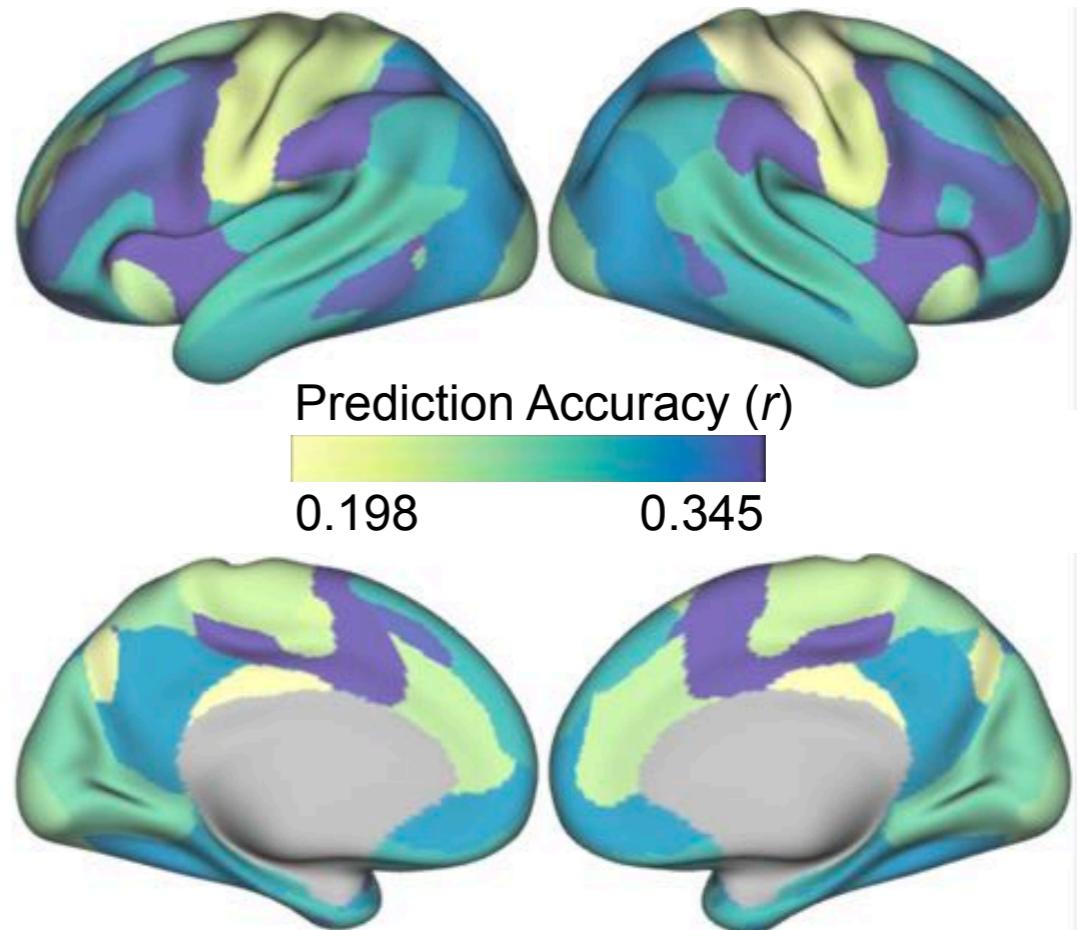
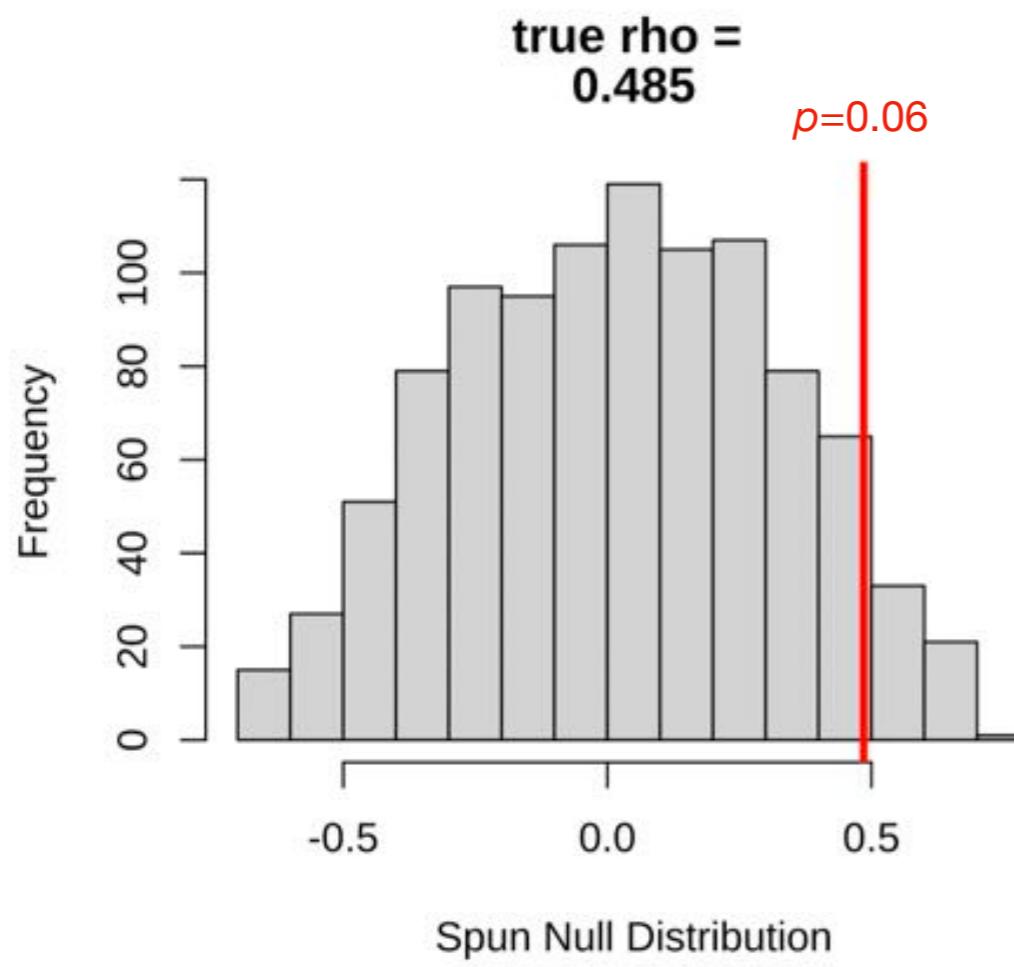
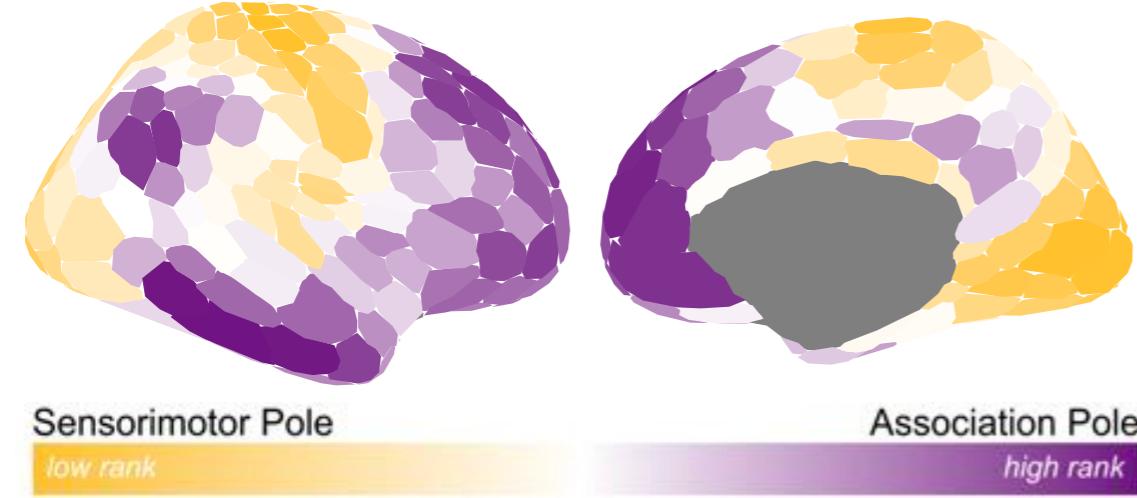


these ten participants had the longest duration
of low-motion quality resting-state data
exceeding 20 minutes allowing us to derive
PFNs separately in two 10-minute halves

Which networks are driving this effect?



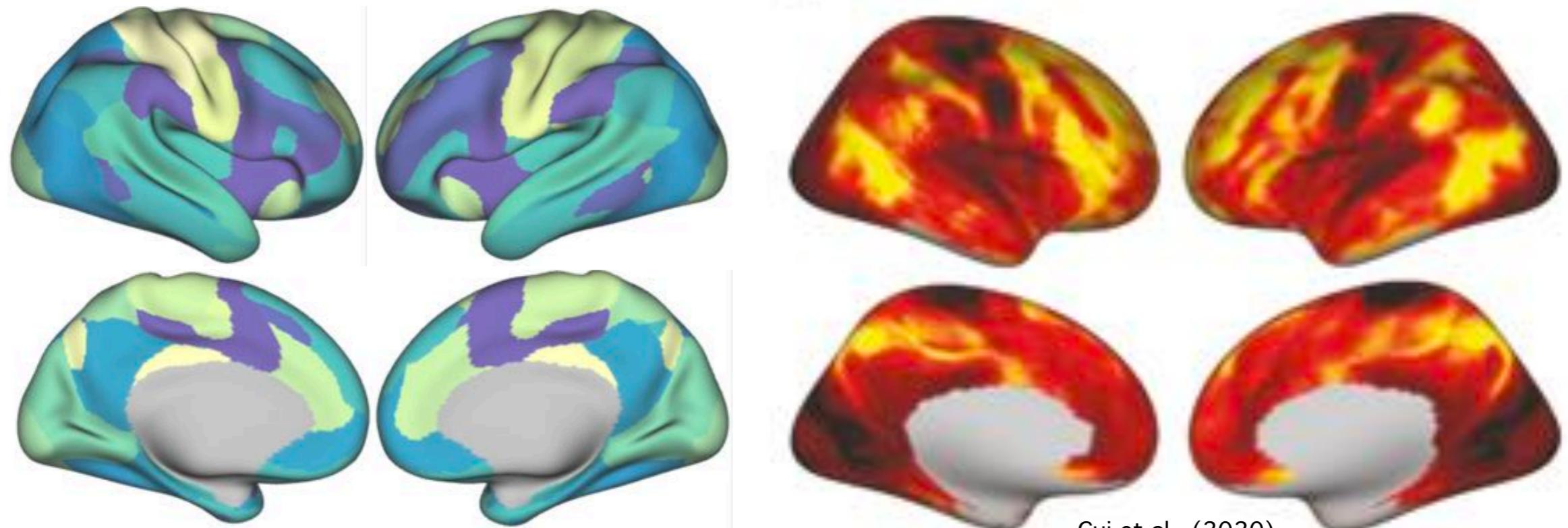
A QUICK TANGENT



I mean... it's not *not*
the S-A axis

A QUICK TANGENT

It would kind of make sense if the areas of the brain that are the most impacted by the environment are also most variable across individuals!!



Cui et al., (2020)

Networks that differ the most by exposome score

Networks that differ the most between people

Okay but real talk

#IsEverythingTheSAaxis

Outline

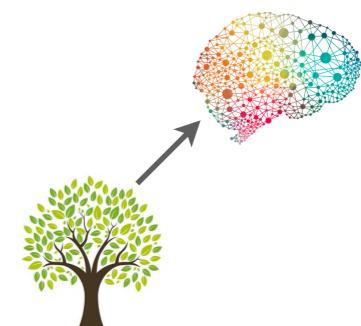
I. Dimensionality reduction of exposome, brain & behavior



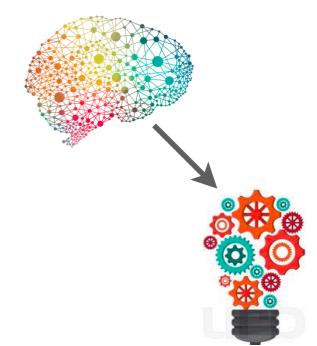
2. Exp-Factor is associated with current and future cognition



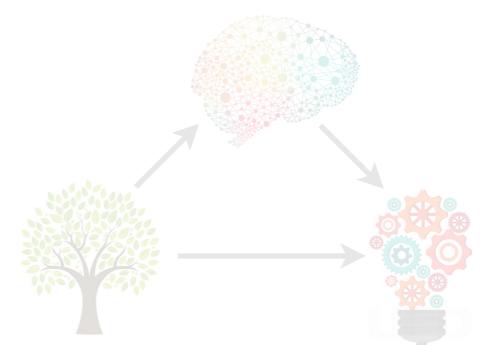
3. Exp-Factor is reflected in functional brain organization



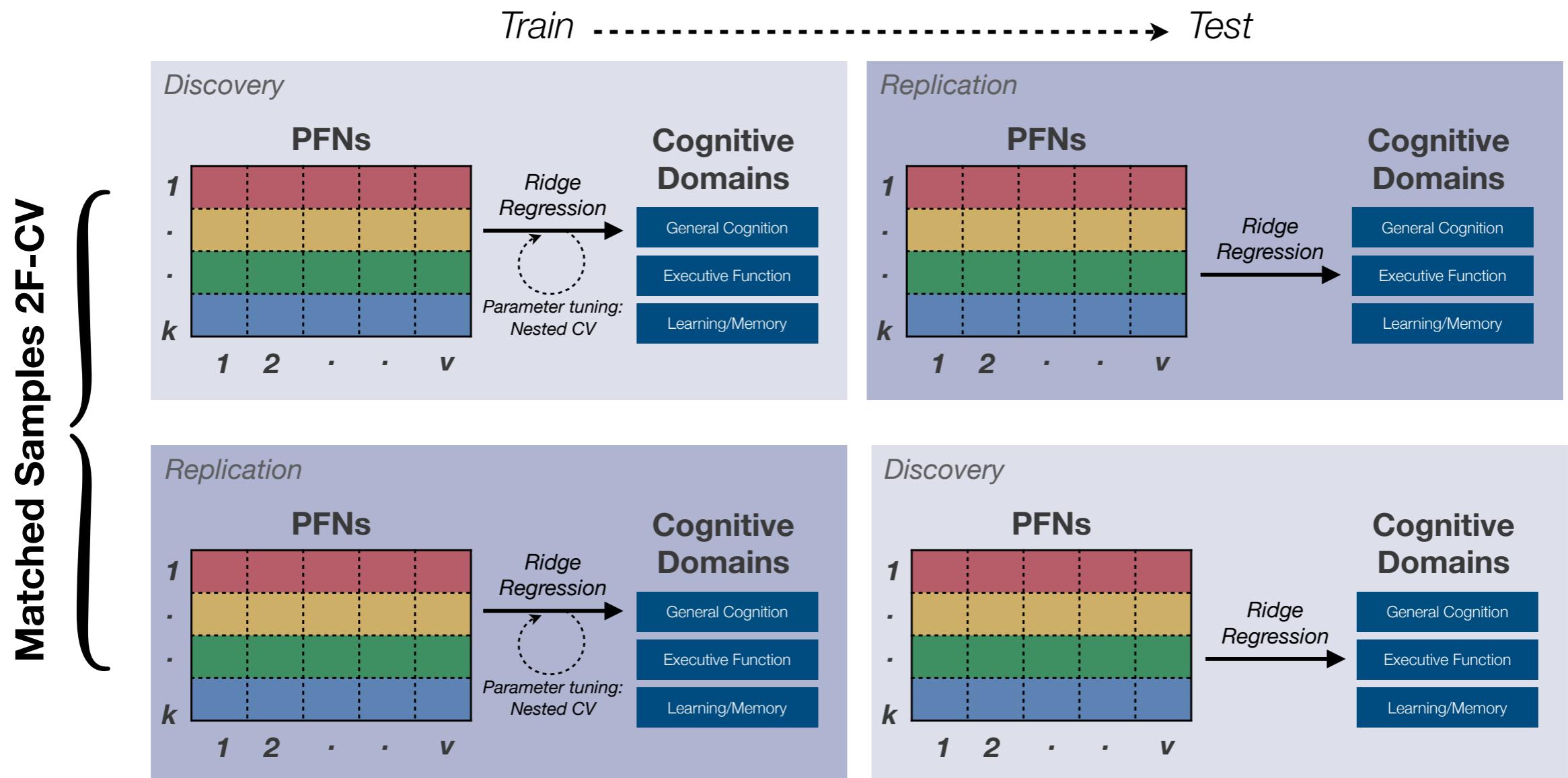
4. How does brain organization relate to cognitive abilities?



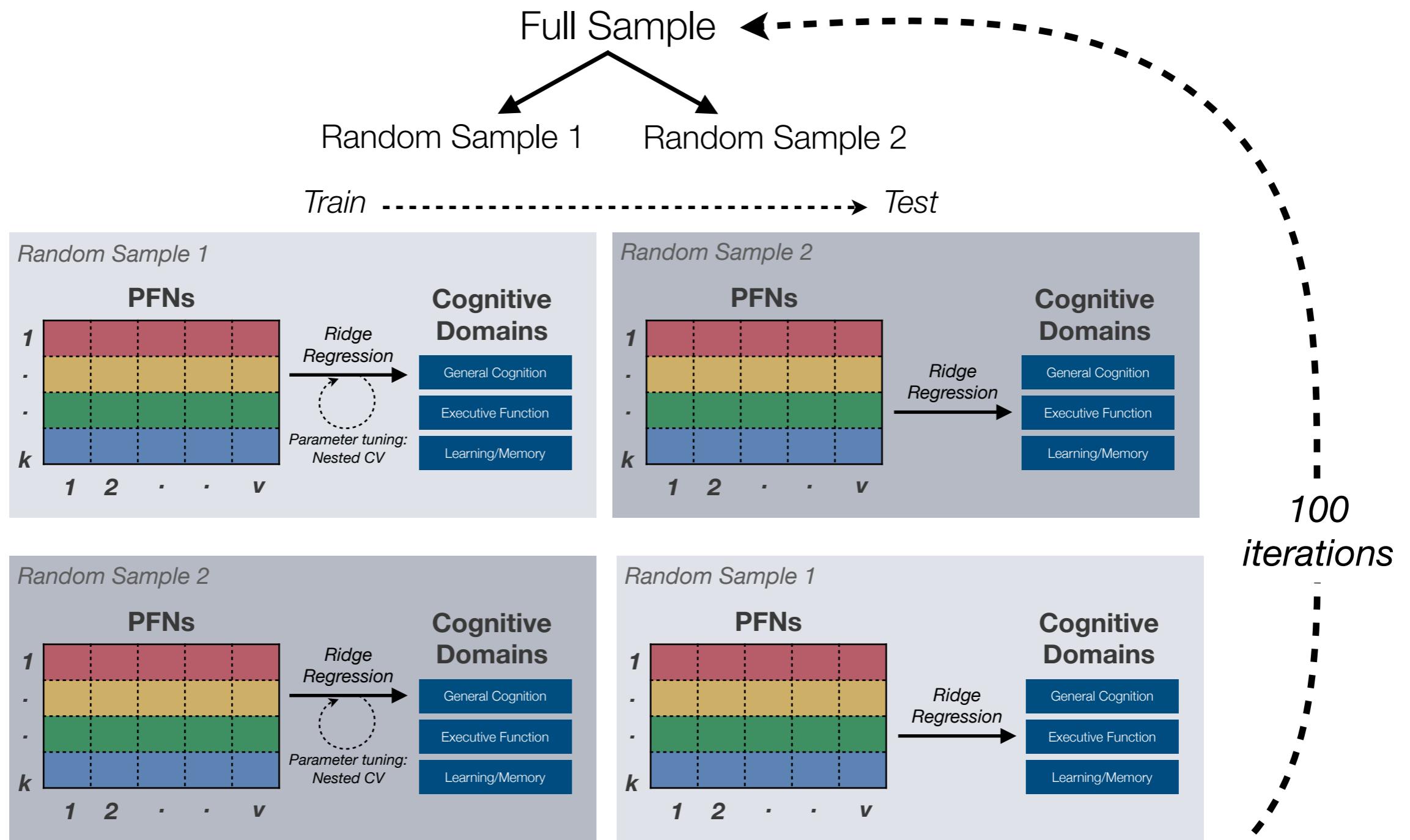
5. Putting it all together!



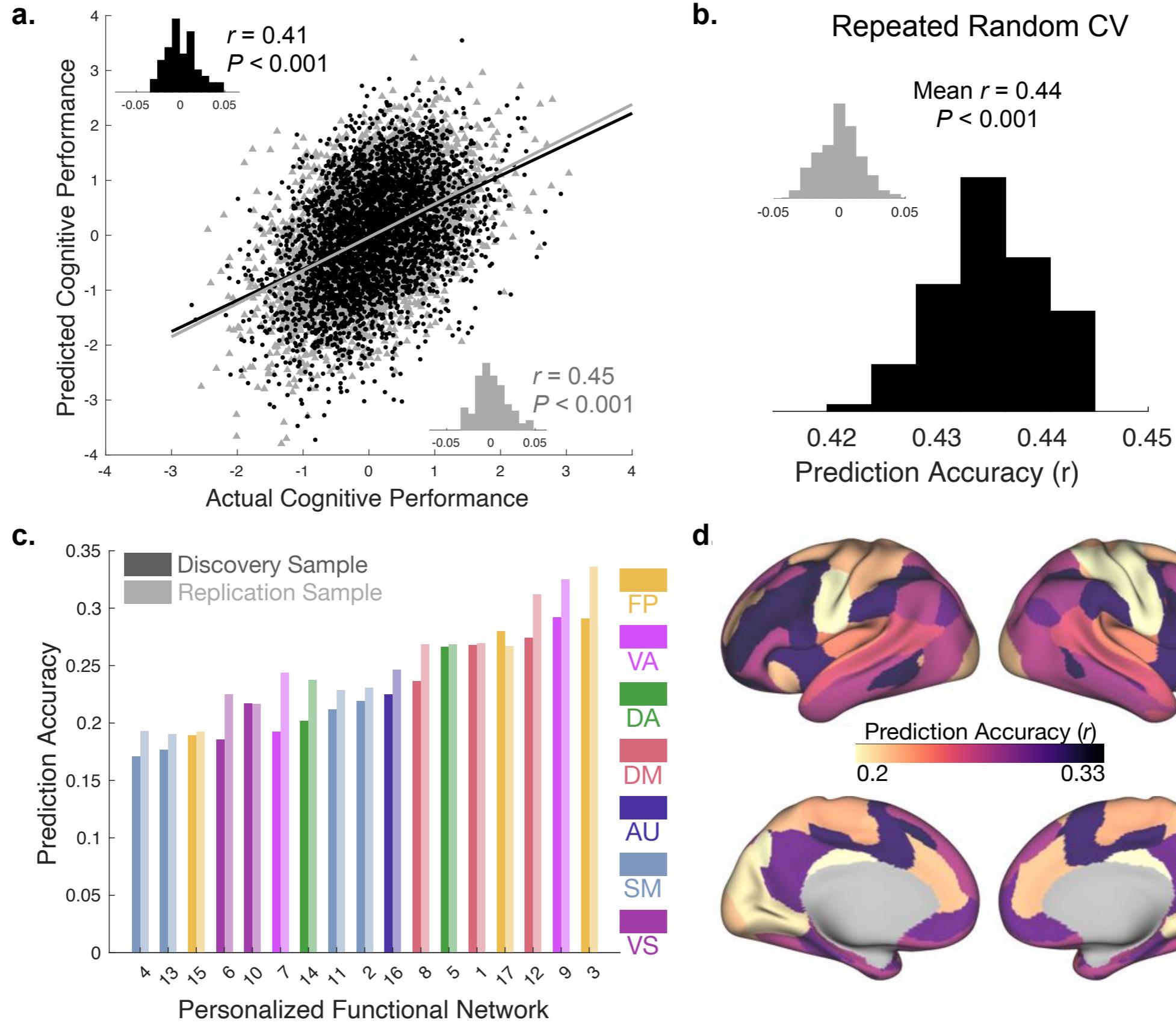
Relating PFN topography to cognition



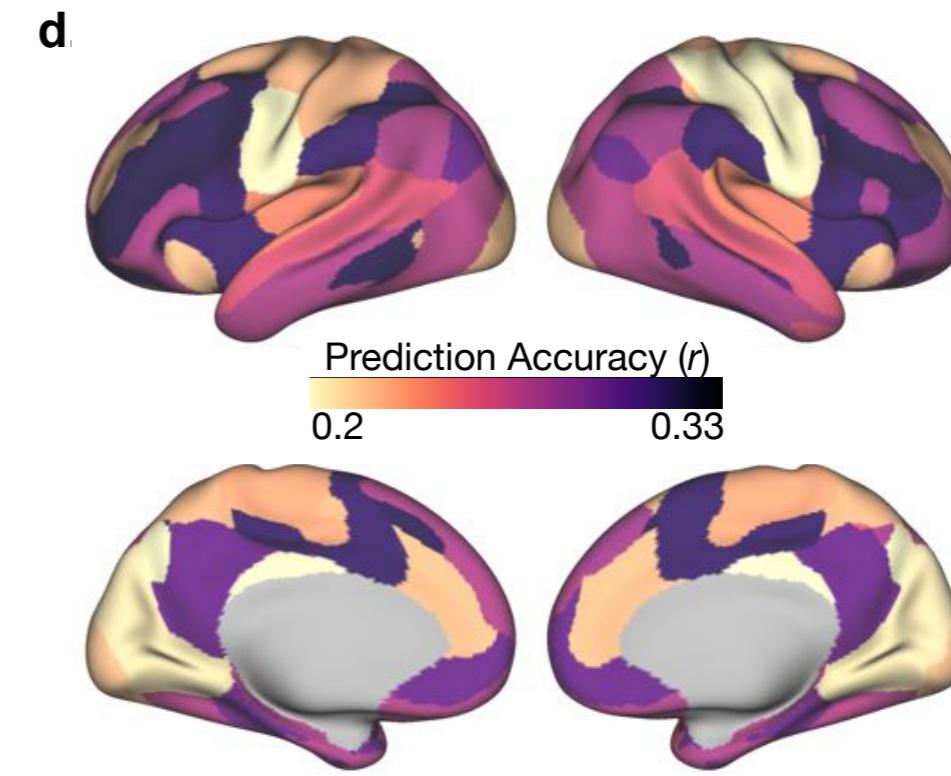
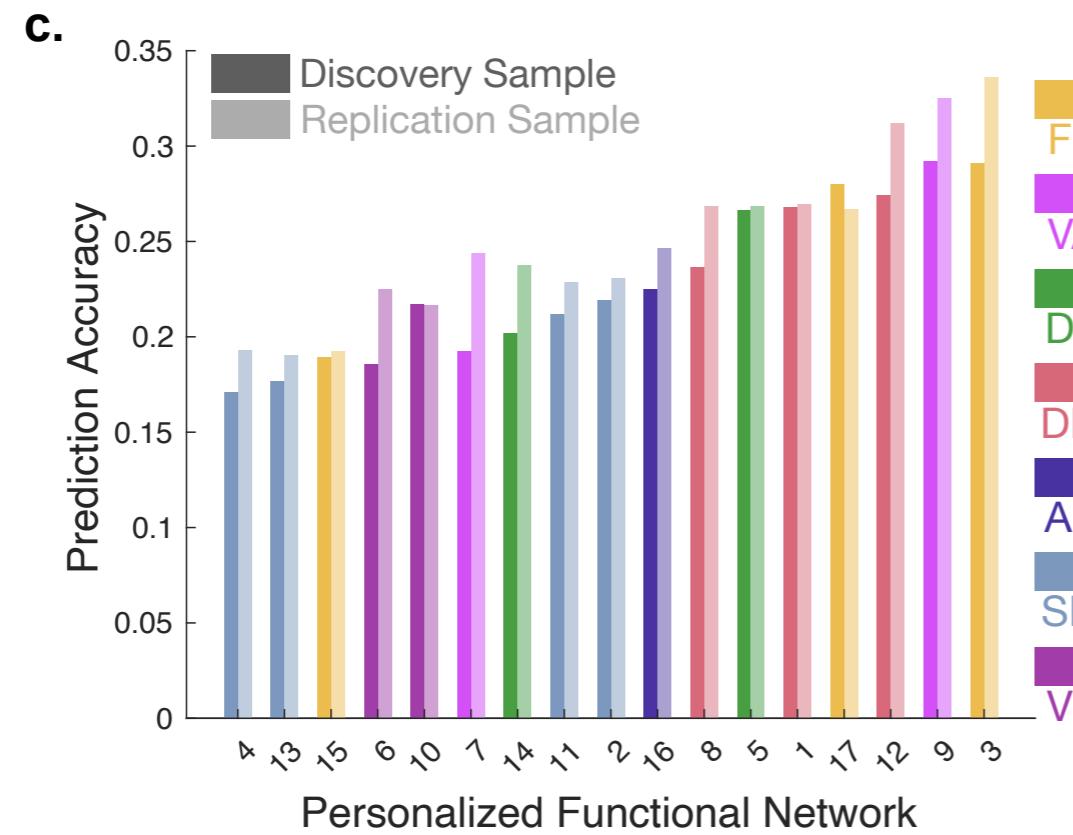
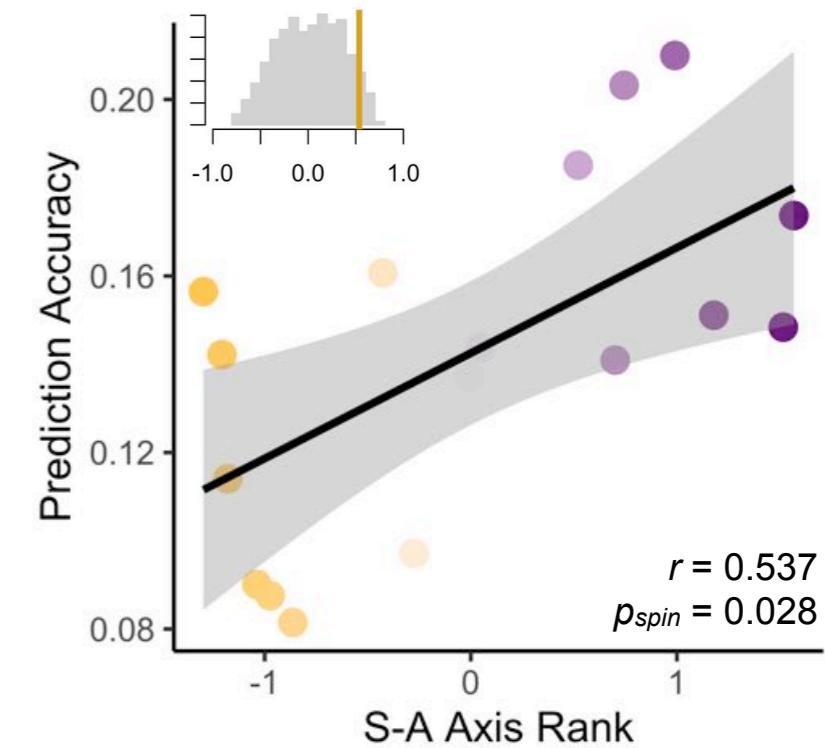
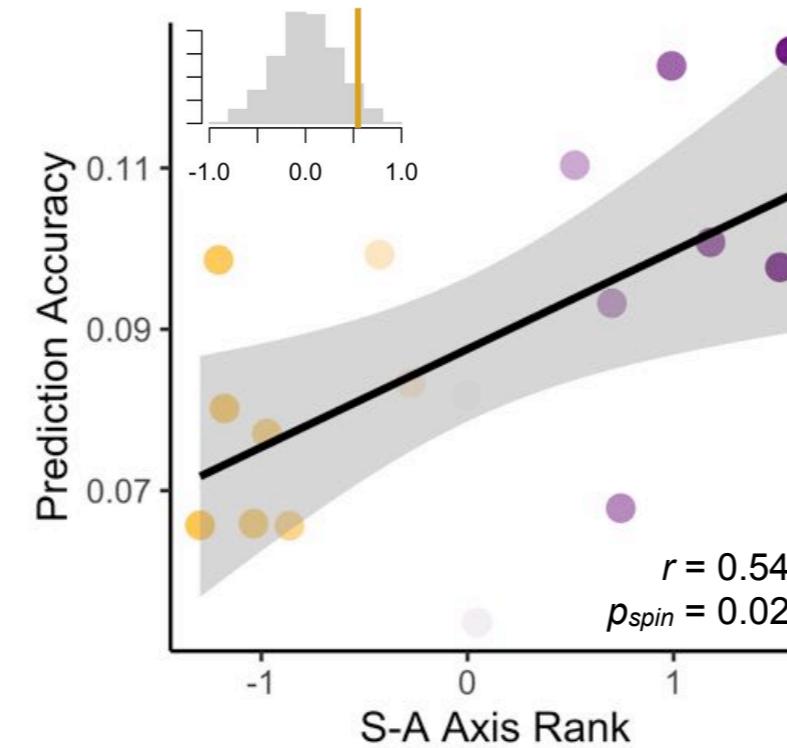
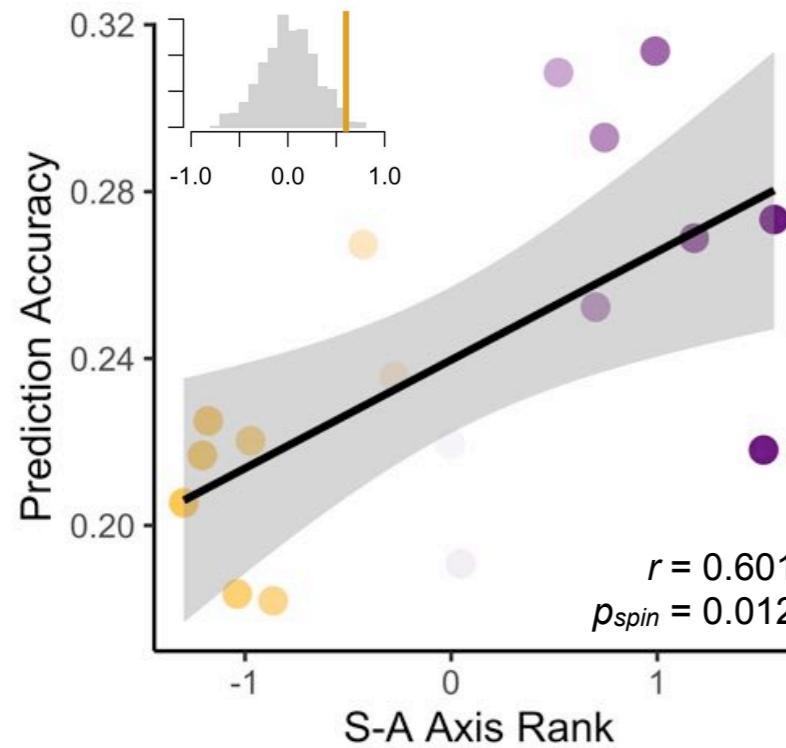
Relating PFN topography to cognition



PFN topography is associated with cognition



This one actually is the S-A axis



Outline

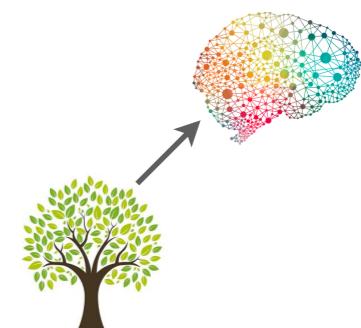
I. Dimensionality reduction of exposome, brain & behavior



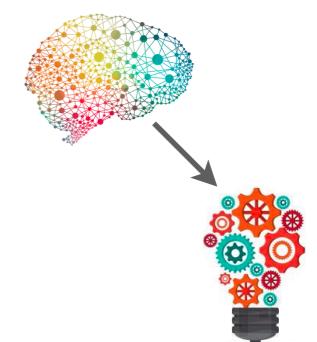
2. Exp-Factor is associated with current and future cognition



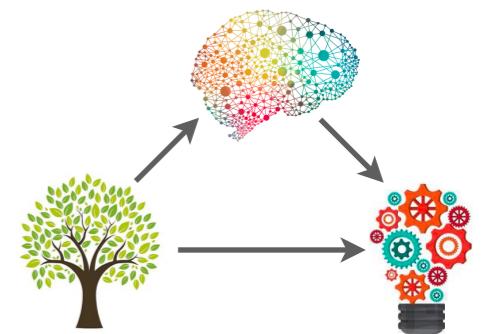
3. Exp-Factor is reflected in functional brain organization



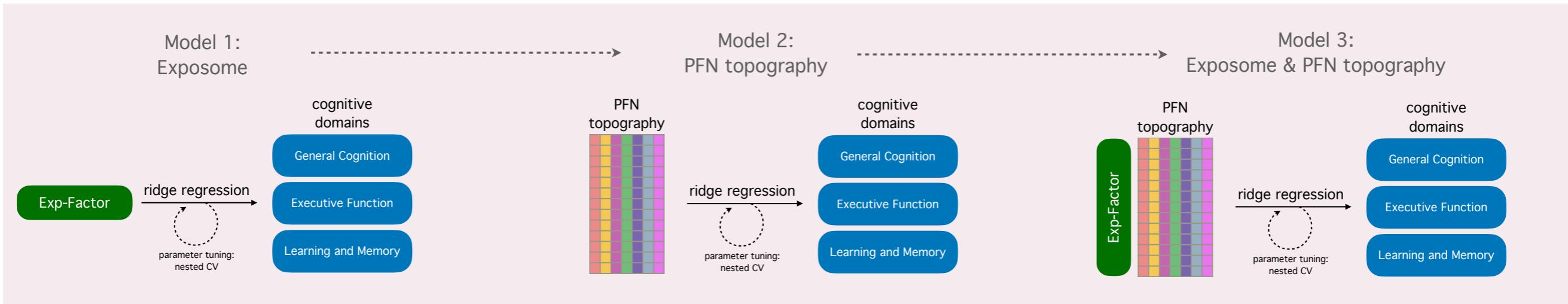
4. PFN functional topography is associated with cognition



5. Putting it all together!



Which model best predicts cognition?



the underdog



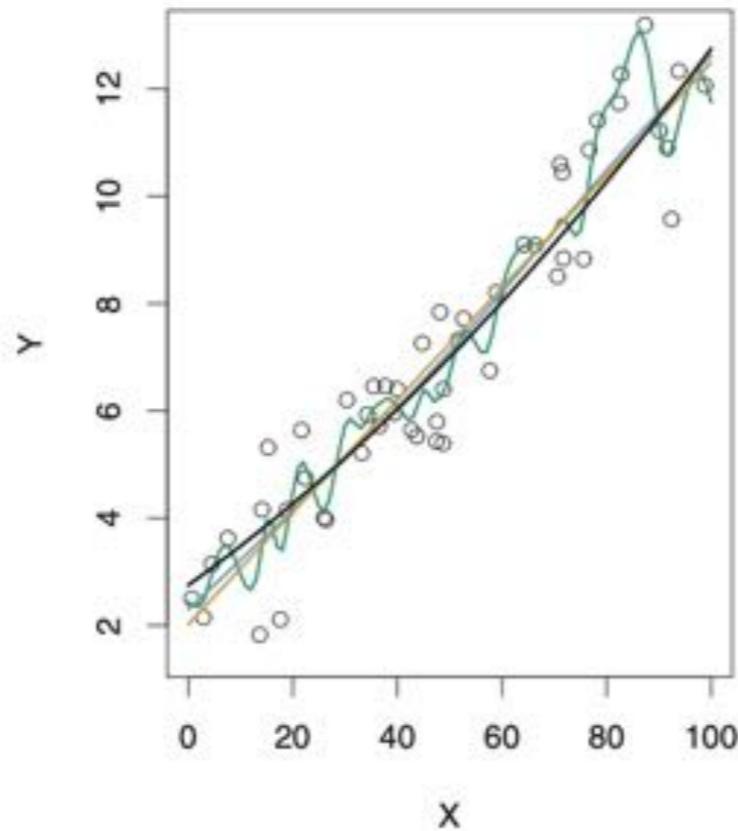
the obvious fan favorite



We'll use metrics that balance model accuracy with model complexity



Why do we want to balance model complexity with model accuracy?



Model Comparison

Prediction Accuracy	Discovery				Replication			
	r	p	AIC	BIC	r	p	AIC	BIC
General Cognition								
Exp-Factor	0.42	2.65 x 10 ⁻¹⁴⁸	-248.8198	-8.0250	0.46	1.17 x 10 ⁻¹⁷⁹	-454.2790	-7.8809
PFN Topography	0.41	3.05 x 10 ⁻¹⁴⁶	2.0198 x 10 ⁶	8.2493 x 10 ⁶	0.45	3.85 x 10 ⁻¹⁷⁴	2.0196 x 10 ⁶	8.2267 x 10 ⁶
Exp-Factor + PFN Topography	0.44	2.44 x 10 ⁻¹⁶⁶	2.0196 x 10 ⁶	8.2491 x 10 ⁶	0.48	3.30 x 10 ⁻¹⁹⁴	2.0195 x 10 ⁶	8.2270 x 10 ⁶
Executive Function								
Exp-Factor	0.11	8.86 x 10 ⁻¹¹	1217.1946	-8.8570	0.14	7.30 x 10 ⁻¹⁶	1035.4933	-8.7450
PFN Topography	0.17	1.37 x 10 ⁻²³	2.0210 x 10 ⁶	8.2493 x 10 ⁶	0.16	5.48 x 10 ⁻²²	2.0209 x 10 ⁶	8.2267 x 10 ⁶
Exp-Factor + PFN Topography	0.17	4.41 x 10 ⁻²⁴	2.0210 x 10 ⁶	8.2491 x 10 ⁶	0.17	8.54 x 10 ⁻²³	2.0209 x 10 ⁶	8.2270 x 10 ⁶
Learning/Memory								
Exp-Factor	0.25	1.35 x 10 ⁻⁵⁰	470.3910	-8.4332	0.27	6.20 x 10 ⁻⁵⁷	386.2874	-8.3685
PFN Topography	0.27	2.06 x 10 ⁻⁶¹	2.0204 x 10 ⁶	8.2493 x 10 ⁶	0.27	2.91 x 10 ⁻⁵⁷	2.0204 x 10 ⁶	8.2267 x 10 ⁶
Exp-Factor + PFN Topography	0.28	3.49 x 10 ⁻⁶⁶	2.0203 x 10 ⁶	8.2491 x 10 ⁶	0.28	4.92 x 10 ⁻⁶³	2.0203 x 10 ⁶	8.2270 x 10 ⁶

ONE variable capturing variability in a child's environment tells us more about their cognition than over a MILLION variables capturing inter-individual heterogeneity in functional topography

This is also true for future cognition

Prediction Accuracy	Discovery				Replication			
	r	p	AIC	BIC	r	p	AIC	BIC
Picture Vocabulary								
Exp-Factor	0.18	5.42 x 10 ⁻⁷	1.8908 x 10 ⁴	-25.6472	0.15	9.75 x 10 ⁻¹²	1.8706 x 10 ⁴	-25.6492
PFN Topography	0.11	3.88 x 10 ⁻⁷	2.0389 x 10 ⁶	7.7267 x 10 ⁶	0.09	1.13 x 10 ⁻⁴	2.0387 x 10 ⁶	7.7151 x 10 ⁶
Exp-Factor + PFN Topography	0.12	6.28 x 10 ⁻⁸	2.0389 x 10 ⁶	7.7267 x 10 ⁶	0.09	3.34 x 10 ⁻⁵	2.0387 x 10 ⁶	7.7151 x 10 ⁶
Flanker								
Exp-Factor	0.11	2.27 x 10 ⁻⁷	1.9389 x 10 ⁴	-26.1050	0.10	2.33 x 10 ⁻⁶	1.9171 x 10 ⁴	-26.0975
PFN Topography	0.08	1.97 x 10 ⁻⁴	2.0394 x 10 ⁶	7.7267 x 10 ⁶	0.08	1.60 x 10 ⁻⁴	2.0392 x 10 ⁶	7.7151 x 10 ⁶
Exp-Factor + PFN Topography	0.08	1.42 x 10 ⁻⁴	2.0394 x 10 ⁶	7.7267 x 10 ⁶	0.08	1.25 x 10 ⁻⁴	2.0392 x 10 ⁶	7.7151 x 10 ⁶
Picture Sequence Memory								
Exp-Factor	0.16	2.12 x 10 ⁻¹³	1.9780 x 10 ⁴	-26.4773	0.18	3.94 x 10 ⁻¹⁷	1.9562 x 10 ⁴	-26.4738
PFN Topography	0.11	1.25 x 10 ⁻⁶	2.0398 x 10 ⁶	7.7267 x 10 ⁶	0.13	5.08 x 10 ⁻⁹	2.0396 x 10 ⁶	7.7151 x 10 ⁶
Exp-Factor + PFN Topography	0.11	3.84 x 10 ⁻⁷	2.0398 x 10 ⁶	7.7267 x 10 ⁶	0.13	8.91 x 10 ⁻¹⁰	2.0396 x 10 ⁶	7.7151 x 10 ⁶
Pattern Comparison								
Exp-Factor	0.05	0.014	1.9562 x 10 ⁴	-26.2696	0.13	3.41 x 10 ⁻⁹	1.9357 x 10 ⁴	-26.2763
PFN Topography	0.06	0.009	2.0396 x 10 ⁶	7.7267 x 10 ⁶	0.04	0.047	2.0394 x 10 ⁶	7.7151 x 10 ⁶
Exp-Factor + PFN Topography	0.06	0.008	2.0396 x 10 ⁶	7.7267 x 10 ⁶	0.05	0.036	2.0394 x 10 ⁶	7.7151 x 10 ⁶
Reading Recognition								
Exp-Factor	0.06	0.003	1.9162 x 10 ⁴	-25.8895	0.12	3.52 x 10 ⁻⁸	1.8942 x 10 ⁴	-25.8765
PFN Topography	0.04	0.074	2.0392 x 10 ⁶	7.7267 x 10 ⁶	0.05	0.018	2.0392 x 10 ⁶	7.7151 x 10 ⁶
Exp-Factor + PFN Topography	0.04	0.062	2.0389 x 10 ⁶	7.7267 x 10 ⁶	0.05	0.013	2.0390 x 10 ⁶	7.7151 x 10 ⁶

It's also better than just knowing SES

Current findings

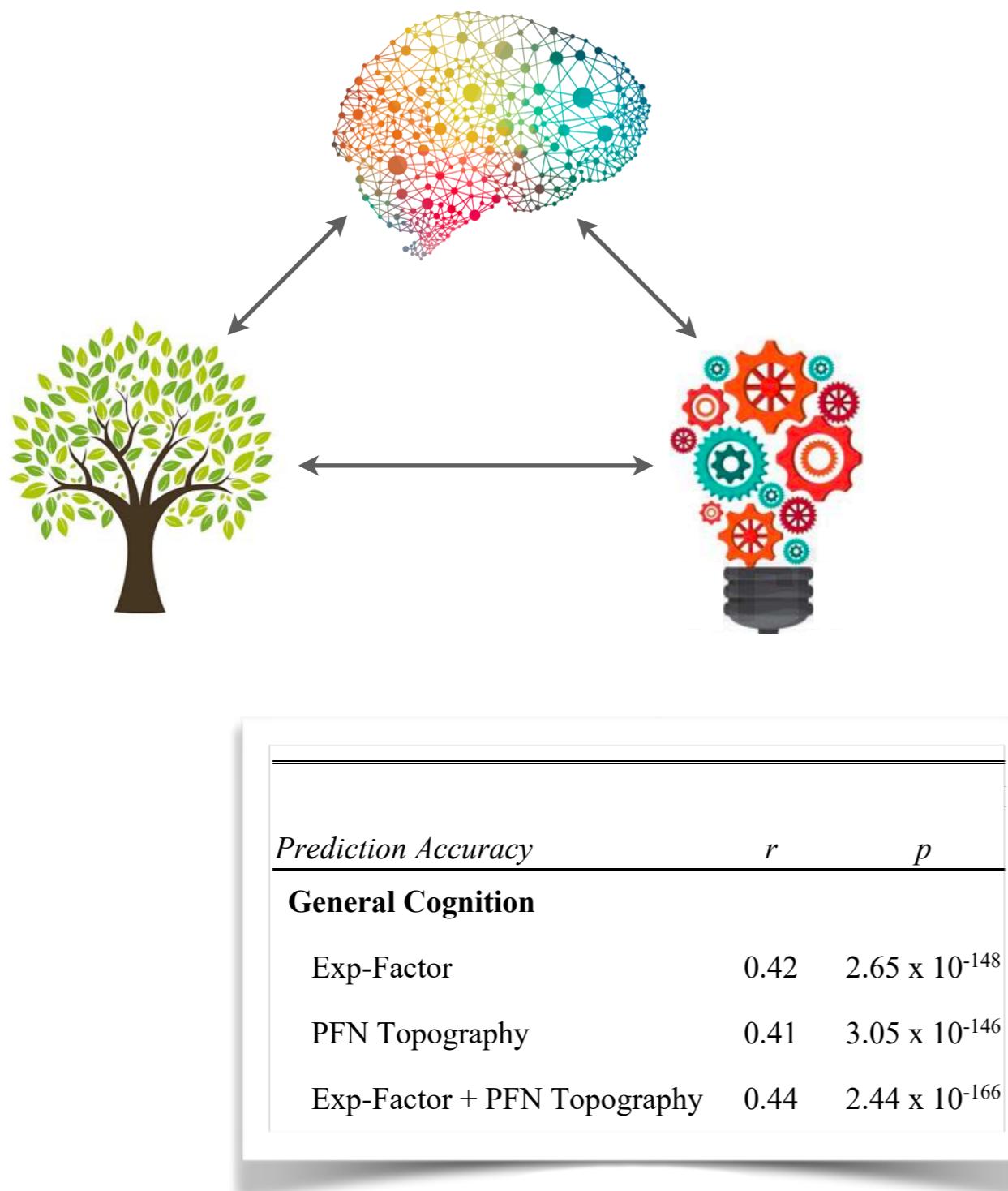
<i>Prediction Accuracy</i>	Discovery		Replication	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
General Cognition				
Exp-Factor	0.42	2.65×10^{-148}	0.46	1.17×10^{-179}
PFN Topography	0.41	3.05×10^{-146}	0.45	3.85×10^{-174}
Exp-Factor + PFN Topography	0.44	2.44×10^{-166}	0.48	3.30×10^{-194}
Executive Function				
Exp-Factor	0.11	8.86×10^{-11}	0.14	7.30×10^{-16}
PFN Topography	0.17	1.37×10^{-23}	0.16	5.48×10^{-22}
Exp-Factor + PFN Topography	0.17	4.41×10^{-24}	0.17	8.54×10^{-23}
Learning/Memory				
Exp-Factor	0.25	1.35×10^{-50}	0.27	6.20×10^{-57}
PFN Topography	0.27	2.06×10^{-61}	0.27	2.91×10^{-57}
Exp-Factor + PFN Topography	0.28	3.49×10^{-66}	0.28	4.92×10^{-63}

Previous findings

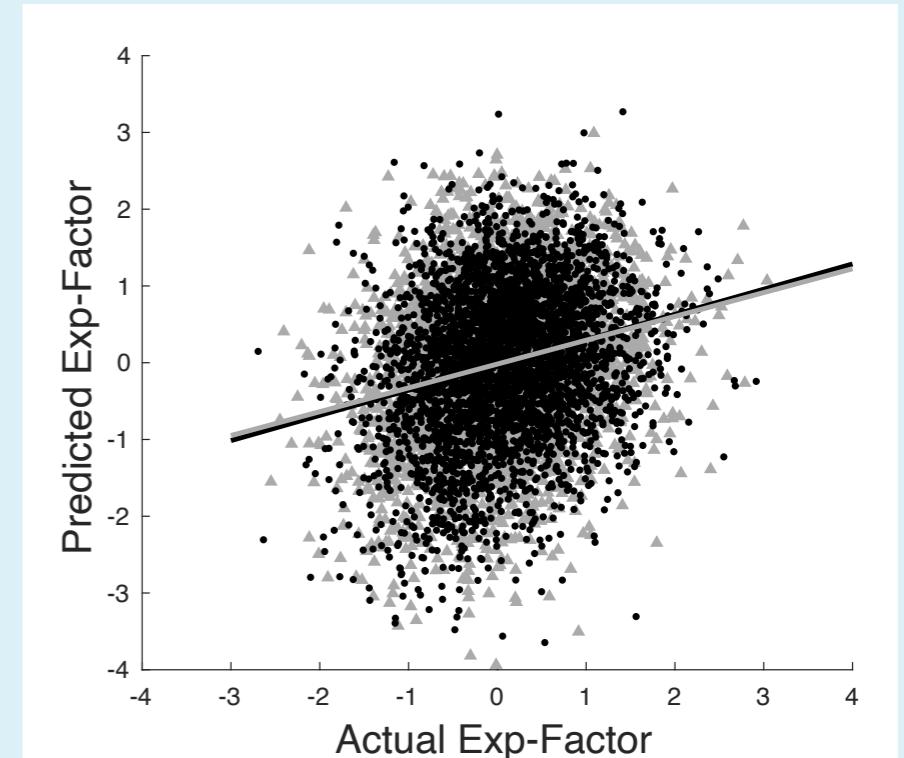
<i>Prediction Accuracy</i>	Discovery		Replication	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
General Cognition				
SES	0.26	1.35×10^{-51}	0.28	4.77×10^{-58}
PFN Topography	0.41	3.05×10^{-146}	0.45	3.85×10^{-174}
SES + PFN Topography	0.43	1.01×10^{-151}	0.46	1.80×10^{-171}
Executive Function				
SES	0.07	1.14×10^{-4}	0.09	3.25×10^{-7}
PFN Topography	0.17	1.37×10^{-23}	0.16	5.48×10^{-22}
SES + PFN Topography	0.17	7.18×10^{-22}	0.17	2.59×10^{-23}
Learning/Memory				
SES	0.13	2.96×10^{-13}	0.16	4.46×10^{-19}
PFN Topography	0.27	2.06×10^{-61}	0.27	2.91×10^{-57}
SES + PFN Topography	0.27	3.53×10^{-57}	0.27	2.35×10^{-56}

Exp-Factor captures a lot more than household income, parental education and neighborhood disadvantage

How much of this is because of overlapping variance explained?



Residual Exp-Factor After Regressing Out Cognition



$$r(3524) = 0.240, p = 2.846 \times 10^{-47}$$
$$r(3448) = 0.233, p = 1.304 \times 10^{-43}$$

We checked all the boxes!

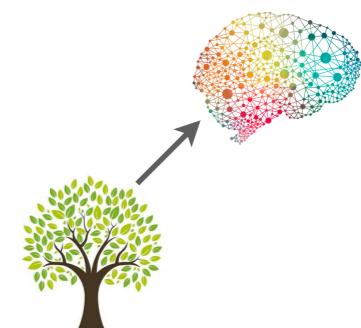
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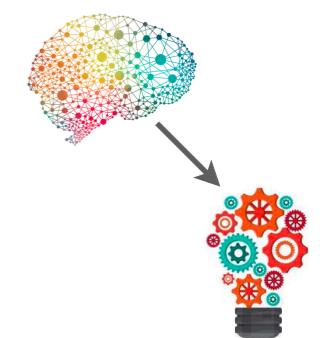
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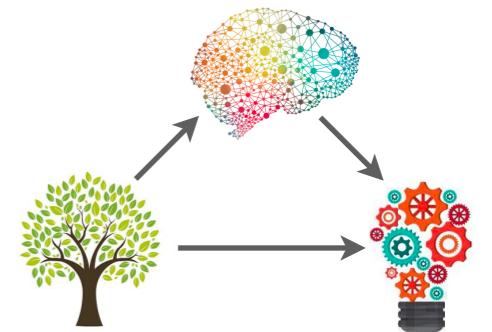
3. Exp-Factor is reflected in functional brain organization



4. PFN functional topography is associated with cognition



5. Exp-Factor predicts cognition better than PFN topography



Summary of Findings

- Exp-factor is associated with cognition:
 - across all cognitive tasks/domains
 - cross-sectionally and longitudinally (over and above baseline cognition)
 - over and above the effects of exposome sub-factors, SES, or psychiatric illness
- Exp-factor is reflected in individual patterns of functional network topography
- Association networks show the most differences associated with Exp-Factor
- Exp-factor and PFN topography make both shared and unique contributions to predictions of individual differences in cognition
- Models trained on Exp-Factor outperform models trained on PFN topography for the most parsimonious predictions of current and future cognition



Future Directions

- Longitudinal changes in neuroimaging measures
 - How do changes in PFN topography relate to changes in cognition?
 - How does a child's exposome affect changes in PFN topography?
 - What is the effect of exposome on cognitive developmental trajectories?
- Sensitive periods (when does exposome most affect brain/cognition?)
- Effects of exposome on *rate* of PFN and cognitive development
- Broad goal: balance specificity (e.g. detailed cognitive and environmental measurements) with generalizability (e.g., broad factors and large-scale data)



Thank You!

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