nature human behaviour

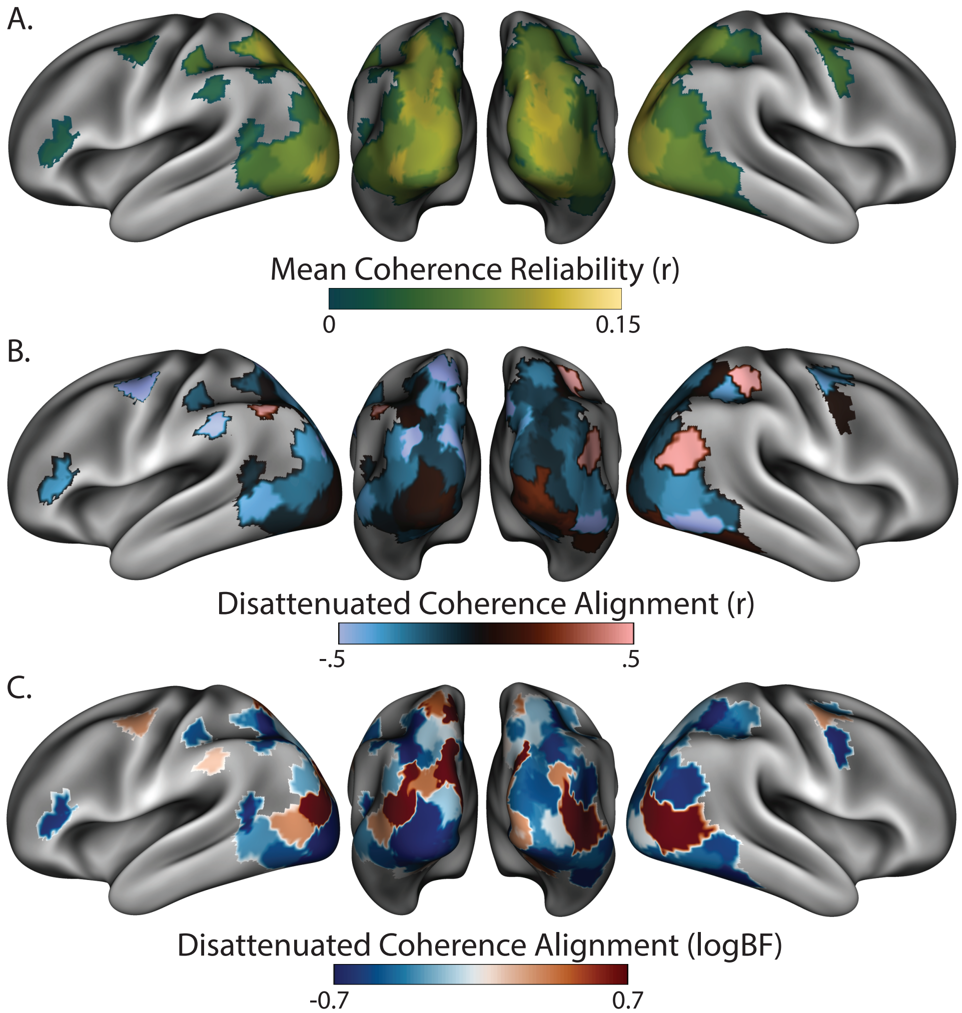
Article

https://doi.org/10.1038/s41562-024-01826-7

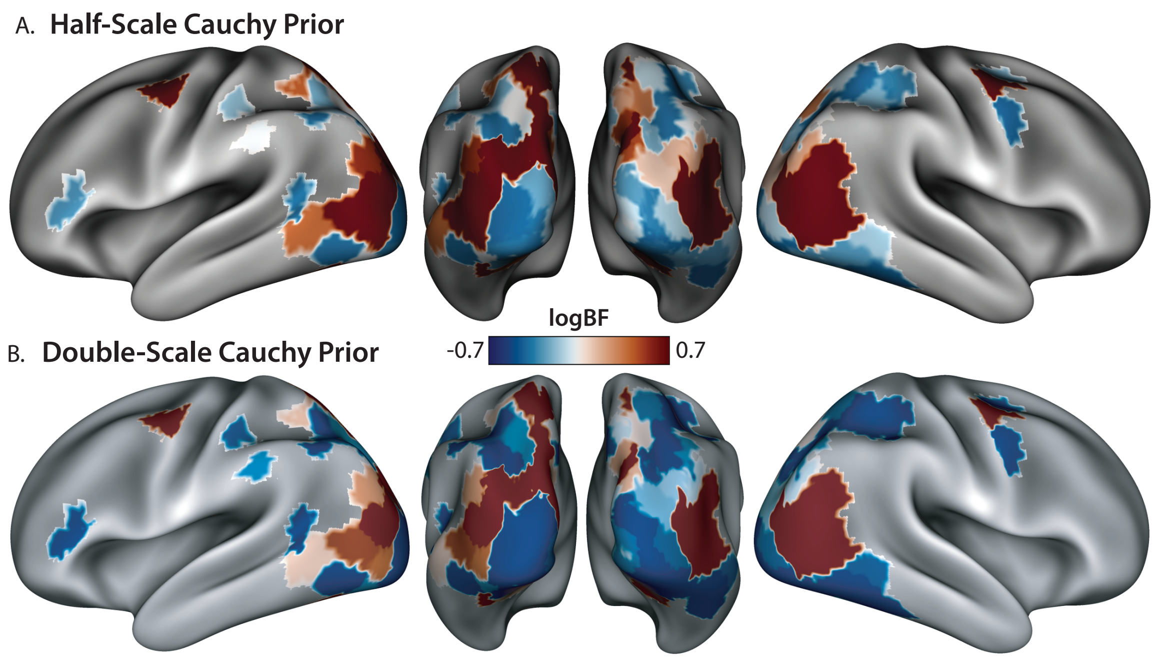
Orthogonal neural encoding of targets and distractors supports multivariate cognitive control

In the format provided by the authors and unedited

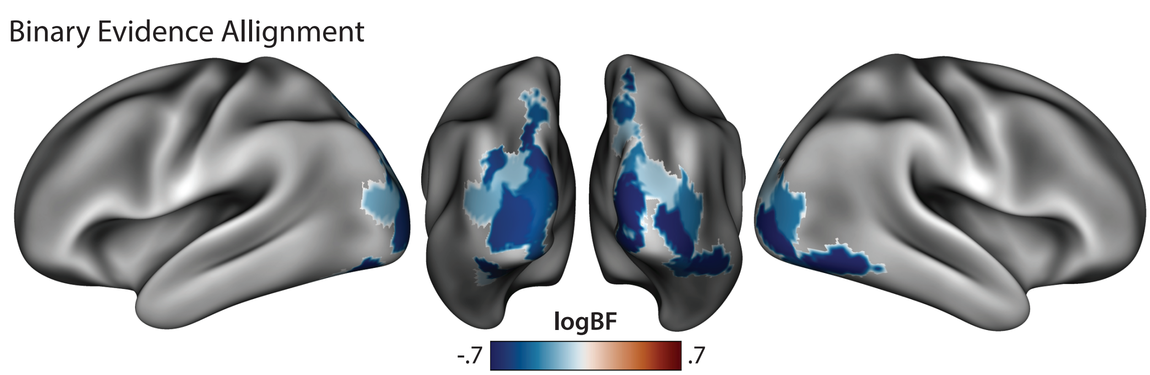
Supplementary Figures



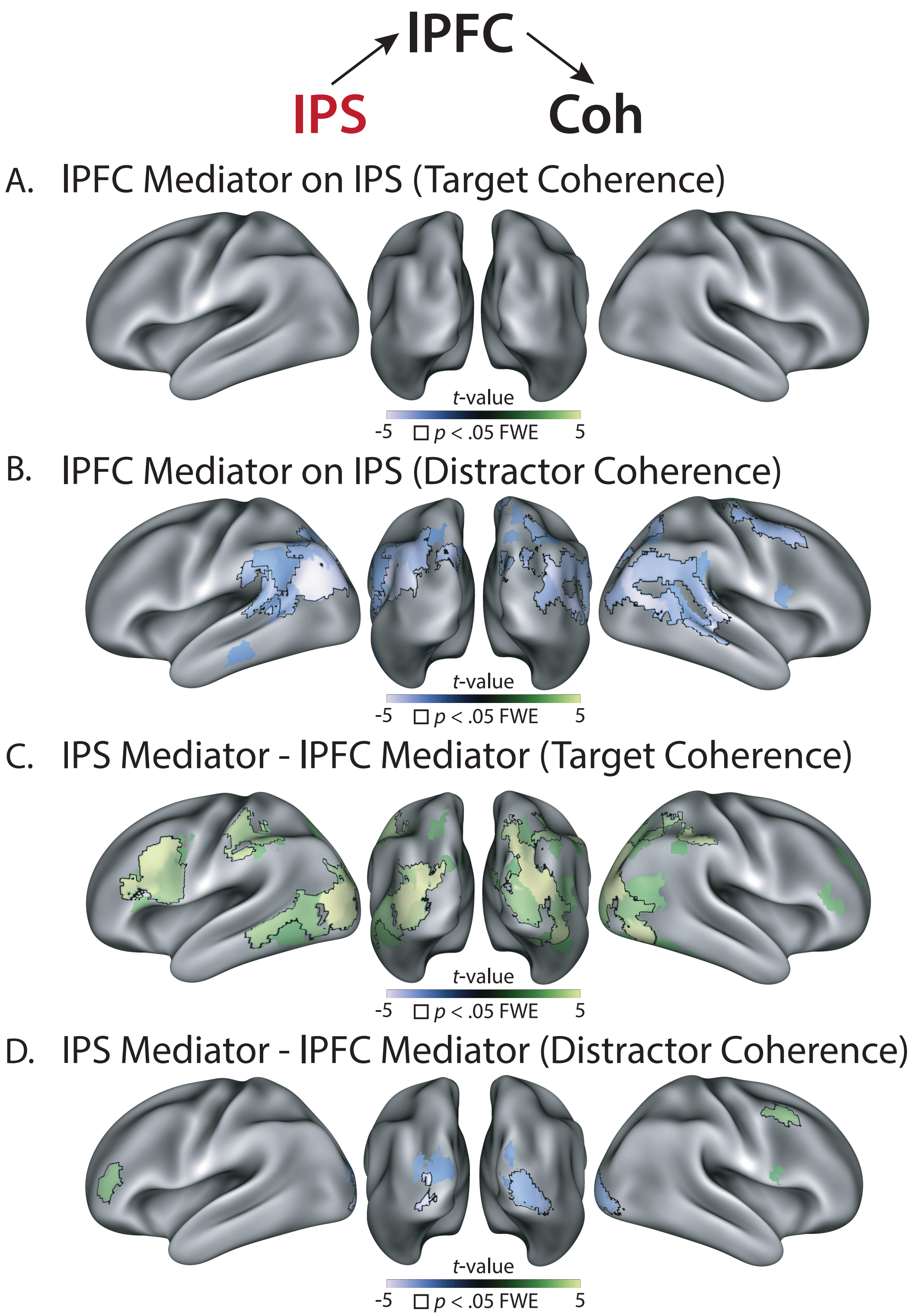
Supplementary Figure 1. *Reliability control analysis.* **A)** Geometric mean of target and distractor coherence reliability ($\sqrt{r_{targ} \times r_{dist}}$), plotted in the reliability-thresholded parcels used in Figure 4. Reliability provides the theoretical upper bound on correlation strength. Median across participants, excluding participants with non-positive reliability. **B)** Target-distractor correlations, normalized by target-distractor reliability (i.e., disattenuated correlations) **C)** Log bayes factors for disattenuated target-distractor correlations. Compare to Figure 4C.



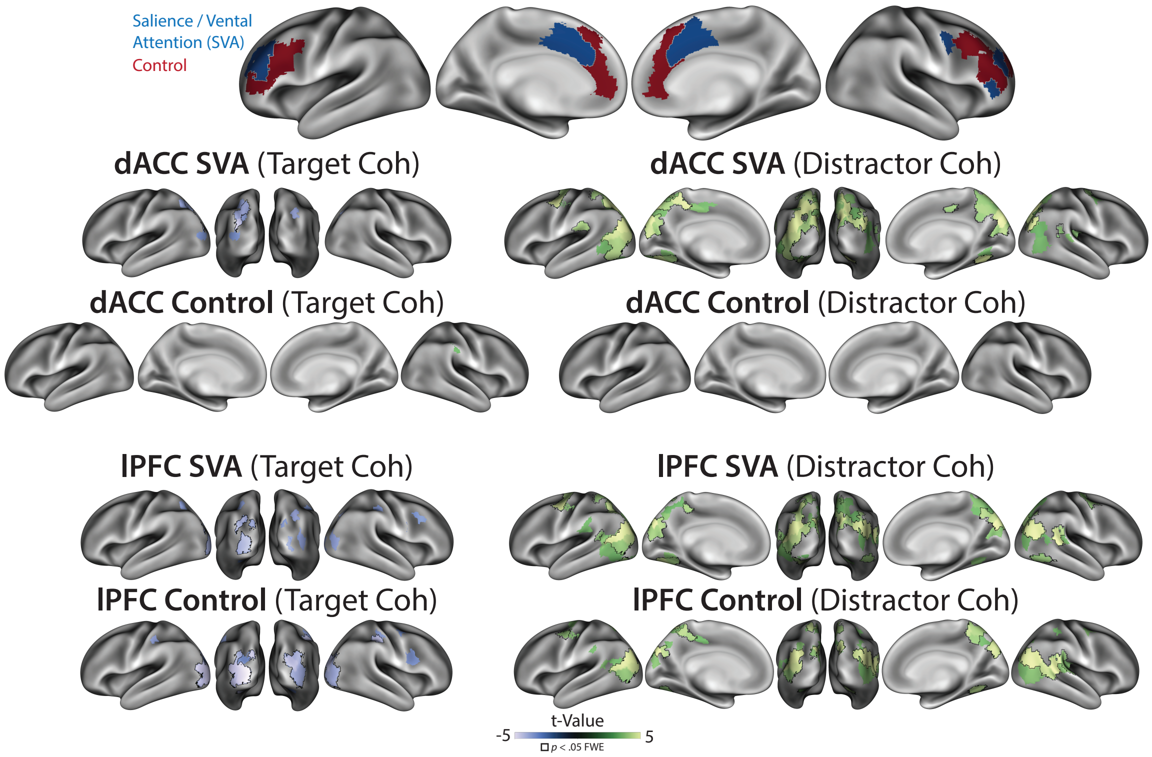
Supplementary Figure 2. *Bayes factor prior control analysis.* **A)** Log bayes factors for target-distractor coherence alignment using a narrower prior (one-half the default Cauchy scale = 0.35). Minimum logBF is -0.46 at $t_{(28)} = 0$. **B)** Same log bayes factor using a wider prior (double the default Cauchy scale = 1.41). Minimum logBF = -0.99 at $t_{(28)} = 0$. Across different prior parameterizations, note the similarity to Figure 4C.



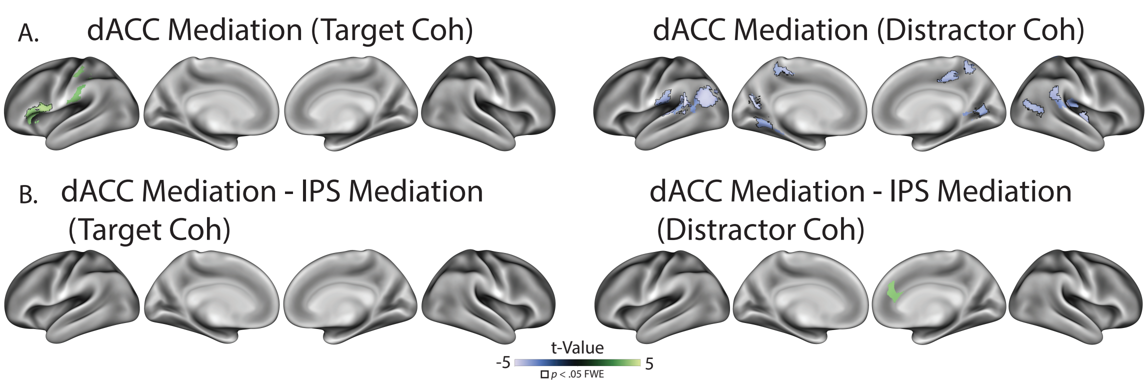
Supplementary Figure 3. *Binary evidence encoding control analysis.* Target-distractor response encoding alignment using binary evidence rather than coherence-modulated evidence. Note the similarity to Figure 4D.



Supplementary Figure 4. *lPFC mediation.* IPS→lPFC→Coherence mediation for target coherence (A) and distractor coherence (B; compare to Figure 7B). Contrast between IPS-mediation and lPFC-mediation for target coherence (C) and distractor coherence (D). Colors reflect two-tailed $p < .001$ (uncorrected), outlines reflect $p < .05$ (corrected with two-tailed max-statistic randomization test).



Supplementary Figure 5. *Coherence alignment with frontal networks.* Activity in 'Salience / Ventral Attention (SVA)' and 'Control' networks within dACC and lPFC (rows), aligned with target and distractor coherence (columns). Note the similarity between dACC SVA parcels and lPFC parcels. Colors reflect two-tailed $p < .001$ (uncorrected), outlines reflect $p < .05$ (corrected with two-tailed max-statistic randomization test).



Supplementary Figure 6. *IPS mediation of dACC connectivity.* **A)** IPS mediation of dACC connectivity (difference in dACC-coherence alignment with and without including IPS predictors). B) Difference between 'IPS mediation of dACC' and 'dACC mediation of IPS'. The lack of activation suggests that this relationship is bidirectional or originates from a common cause. dACC seed is from the 'Salience / Ventral Attention' network (see Supplementary Figure 11). Colors reflect two-tailed $p < .001$ (uncorrected), outlines reflect $p < .05$ (corrected with two-tailed max-statistic randomization test).

Supplementary Tables

Task Feature	**SPL**	**IPS**	**SPL − IPS**
Target Evidence	$t_{(28)} = 10.39$, $p < .001$, logBF = 8.37, 95% CI [.0315, .0470]	$t_{(28)} = 5.82$, $p < .001$, logBF = 3.81, 95% CI [0.0168, 0.0351]	$t_{(28)} = 3.89$, $p < .001$, logBF = 1.75 95% CI [0.0063, 0.0203]
Distractor Evidence	$t_{(28)} = 4.42$, $p < .001$, logBF = 2.30, 95% CI [0.0108, 0.0293]	$t_{(28)} = 3.62$, $p = 0.0012$, logBF = 1.47, 95% CI [0.0075, 0.0272]	$t_{(28)} = 0.896$, $p = .378$, logBF = -0.545 95% CI [-0.0035, 0.0088]
Target-Distractor Evidence Alignment	$t_{(28)} = -0.703$, $p = .488$, logBF = -0.606, 95% CI [-0.0054, 0.0026]	$t_{(28)} = -0.436$, $p = .666$, logBF = -0.667 95% CI [-0.0062, 0.0040]	$t_{(28)} = -0.145$, $p = .886$, logBF = -0.701 95% CI [-0.0044, 0.0038]
Target Coherence	$t_{(28)} = 5.82$, $p < .001$, logBF = 3.82, 95% CI [0.0279, 0.0581]	$t_{(28)} = 7.73$, $p < .001$, logBF = 5.83, 95% CI [0.0620, 0.1066]	$t_{(28)} = -3.89$, $p < .001$, logBF = 6.14 95% CI [-0.0518, -0.0308]
Distractor Coherence	$t_{(28)} = 8.88$, $p < .001$, logBF = 6.97, 95% CI [0.0500, 0.0799]	$t_{(28)} = 8.53$, $p < .001$, logBF = 6.63 95% CI [0.0450, 0.0734]	$t_{(28)} = 1.40$, $p = .170$, logBF = -0.320 95% CI [-0.0026, 0.0142]
Target-Distractor Coherence Alignment	$t_{(28)} = -4.75$, $p < .001$, logBF = 2.65, 95% CI [-0.0234, -0.0093]	$t_{(28)} = -1.06$, $p = 0.294$, logBF = -0.479 95% CI [-0.0159, 0.0050]	$t_{(28)} = -2.99$, $p = .0058$, logBF = 0.861 95% CI [-0.0183, -0.0034]

Supplementary Table 1. *Feature encoding contrasted across parietal cortex.* Encoding of feature evidence and coherence within SPL, within IPS, and contrasted between SPL and IPS. Statistical tests are two-tailed and uncorrected for multiple comparisons. Note the stronger target evidence encoding in SPL, stronger target coherence encoding in IPS, and stronger target-distractor coherence alignment in SPL.

Correlation	**Covariates**	**dACC**	**lPFC**	**SPL**	**IPS**
Target-Accuracy, Target-RT	Target, Accuracy, RT	$r_{(27)} = -0.32$ $p = .11$	$r_{(27)} = -0.36$ $p = .067$	$r_{(27)} = -0.11$ $p = .56$	$r_{(27)} = -0.47$ $p = .017$
Distractor-Accuracy, Distractor-RT	Distractor, Accuracy, RT	$r_{(27)} = -0.71$ $p < .001$	$r_{(27)} = -0.43$ $p = .027$	$r_{(27)} = -0.48$ $p = .012$	$r_{(27)} = -0.59$ $p = .0014$

Supplementary Table 2. *Partial correlations between coherence and performance*. Correlations between individual differences in coherence-performance alignment, controlling for coherence and performance encoding reliability (No correction for multiple comparisons). Since reliability determines alignment [66], individual differences in alignment may be confounded with individual differences in reliability. Overall, these results are qualitatively similar to the zero-order correlation (see Figure 6), albeit with weaker correlations for target coherence. Note that these correlations are particularly robust in IPS.