Supplementary Materials

Functional magnetic resonance imaging (fMRI) acquisition and preprocessing

FMRI acquisition parameters were the same in both datasets and have been detailed in previous work (1). FMRI data were collected with harmonized Siemens 3T scanners using a 64-channel head coil at Yale's Magnetic Resonance Research Center. An anatomical scan was collected using a magnetization-prepared rapid gradient echo sequence (repetition time=2400ms, echo time=1.22ms, voxel size=1x1x1mm). FMRI was acquired using a multiband gradient echo-planar imaging sequence (repetition time=1000ms, echo time=30ms, voxel size=2x2x2mm, multiband factor=5). Participants watched three movie clips for the naturalistic paradigm without a break (*Inside Out*, *The Princess Bride*, and *Up*). In the drug cue paradigm, participants were presented with alternating rest and cue blocks. Each condition had 9 blocks, each lasting 16 seconds. Participants were shown either a fixation crosshair (rest condition) or a picture depicting opioid-related stimuli (cue condition).

Neuroimaging data were collected from 103 participants with OUD. For the naturalistic paradigm, we first excluded participants who did not complete the task or had mean framewise displacement (MFD) over 0.2mm (N=24). One participant was excluded due to having epilepsy. After removing two additional participants with missing brain coverage, a final sample of 76 individuals with OUD was analyzed for group comparison. For the drug cue task, we removed 29 participants who did not complete the drug cue task or showed excessive motion (i.e., MFD > 0.2mm). Two participants were excluded due to missing time points in their scan. Two participants were removed due to missing brain coverage. After these exclusion criteria, we extracted brain dynamic measures from 70 participants with OUD.

The transdiagnostic study collected neuroimaging data from 307 participants. Out of these individuals, 294 adult participants completed the naturalistic paradigm. We excluded one participant with missing brain coverage. Three participants were further excluded due to having a wrong number of volumes. Of the 290 participants, 114 were considered healthy control (HC) based on our criteria (see **Methods**). We additionally removed five participants with MFD over 0.2mm. Nine repeated scans were excluded. Three more participants were removed due to issues with scanning sequences. A final sample of 97 HCs were included in our group comparison analysis.

Stroop-assessed cognitive control

As described above, fMRI data from 70 participants with OUD passed quality control. Three of these individuals did not have Stroop data and were excluded from further analysis related to cognitive control. To compute the accuracy interference scores, the portion of trials where participants responded correctly was computed for both the incongruent and control conditions. Next, we subtracted the accurate portion from the incongruent and control conditions. Five participants were excluded due to having outlier performance scores (determined using MATLAB; > 3 median absolute deviations from the median). To compute the response time interference scores, we subtracted the average response time from all accurate trials in the congruent trial from the average response time from all accurate trials in the control condition. Two participants were removed since response time information during the incongruent condition was unavailable. We additionally excluded four participants with outlier response time interference scores. Accuracy and response time interference scores did not differ significantly by sex (accuracy: $t(59)=0.984$, $p=0.329$; $t(59)=-0.452$, $p=0.653$).

Brain states identification

We replicated our prior work to identify recurring brain states. Nonlinear manifold learning and 2-step Diffusion Mapping projected task-based fMRI data from the Human Connectome Project S500 release into a low-dimensional space (2,3). We used minimally preprocessed HCP data from six different tasks (motor, working memory, social, emotional, relational, and gambling) from 390 participants (see 3 for information on quality control and exclusion criteria).

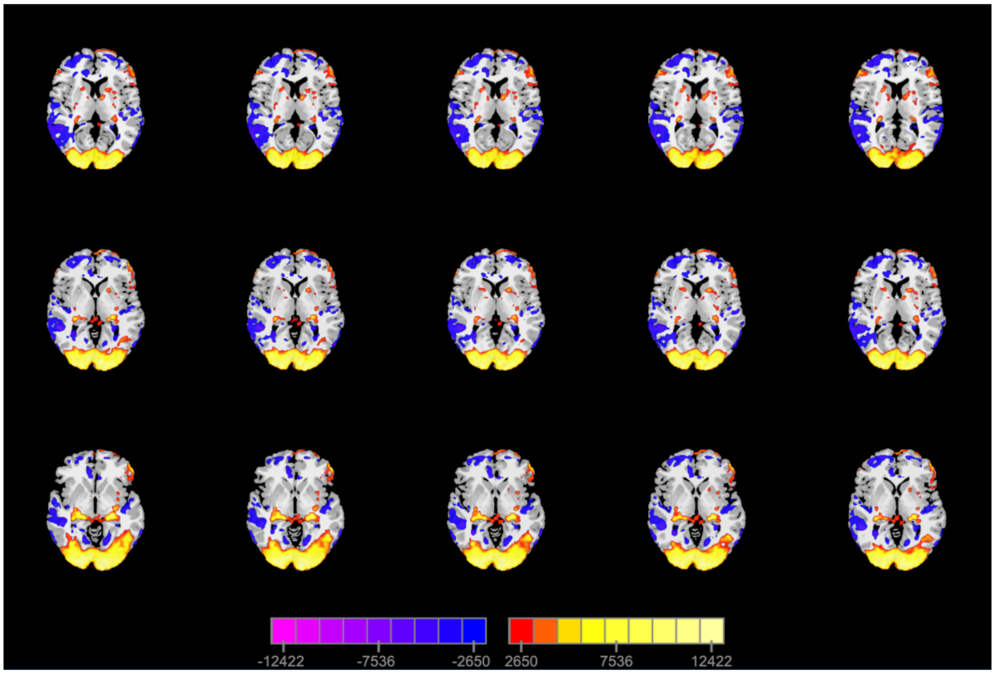
After task data were projected to the low-dimensional space, time points showing similar activity patterns were located closer together. K-means clustering then identified four recurring brain states with distinct activation patterns. The number of brain states was determined using the Calinski-Harabasz criterion (4). We characterized these brain states as fixation, high-cognition, low-cognition, and transition based on the prominent task conditions associated with these brain states (**Supplementary Table 1**). For instance, the fixation state mainly included time points from the fixation condition. The high-cognition state included time points from complex cognitive paradigms such as working memory, emotion, relational, gambling, and social. The low-cognition state involved time points from the motor task, the 0-back working memory condition, and the neutral emotion condition. Lastly, the transition state consisted of time points from the cue condition across various task paradigms. The centroid of each state cluster was extracted to serve as a representative time point in later analyses.

In our prior work (5), we investigated how canonical brain networks contributed to each of these brain states. To this end, we identified the activated and deactivated brain regions (i.e., activation above or below 0, respectively; arbitrary unit) for each representative time point in a set of canonical brain networks. The activation or deactivation percentage was next computed by dividing the number of activated or deactivated brain regions by the total number of brain regions in a network.

Different canonical networks were activated to varying extent in each brain state (**Supplementary Table 2**). However, brain network activation patterns largely followed what cognitive processes each brain state supported. For instance, the entire motor network was activated during low-cognition state whereas the high-cognition state was linked to frontoparietal network activation and default mode network deactivation.

General linear modeling (GLM)

As an exploratory analysis, we also examined whether brain responses during the cue paradigm demonstrated an association with cognitive control. For each participant, a GLM was used to model brain activity. The design matrix included the cue regressor, mean, linear, quadratic, and cubic trend terms, and a 24-parameter motion model. The cue regressor was convolved with a standard hemodynamic response function. Resultant beta maps were spatially smoothed with a 6-mm Gaussian kernel and warped into common space. Beta coefficients were extracted from each node of the Shen-268 atlas and correlated with ACC and RT interference scores.



Supplementary Figure 1. Activations during the drug cue task.

Supplementary Table 1. Number of volumes associated with each task condition for the four recurring brain states

	Fixation	High-cognition	Low-cognition	Transition
Fixation	635	0	20	65
Cue	41	3	6	158
Working memory (0 back)	10	56	99	123
Working memory (2 back)	1	201	10	76
Emotion (Fear)	10	42	0	48
Emotion (Neutral)	23	12	99	16
Gambling (Win)	0	100	25	35
Gambling (Loss)	0	101	10	49
Motor (Tongue)	0	1	52	12
Motor (Left foot)	8	5	41	13
Motor (Left hand)	7	0	45	15
Motor (Right foot)	0	0	55	12
Motor (Right hand)	0	1	50	15
Social (Mental)	0	113	0	47
Social (Random)	0	111	0	109
Relational (Match)	3	9	17	40
Relational (Relation)	3	90	5	9

Supplementary Table 2. Networks showing the highest activation and deactivation percentages for each state

	Fixation	High-cognition	Low-cognition	Cue/transition
Activation percentages	DMN (88.89%)	VAs (100%)	Motor network (100%)	Visual I (100%)
	Motor network (85.71%)	Visual II (88.87%)	MF (86.21%)	VAs (72.22%)
	MF (82.76%)	FP (82.35%)	Cerebellum (84%)	Visual II (66.67%)
Deactivation percentages	VAs (94.44%)	Motor network (87.76%)	Visual I (100%)	MF (89.66%)
	Visual I (66.67%)	DMN (83.33%)	Visual II, VAs, and DMN (66.67%)	DMN (88.87%)
	Visual II (66.67%)	Subcortical (79.31%)		Motor (83.67%)

This table shows the canonical functional networks with the three highest activation and deactivation percentages for each brain state. The actual activation and deactivation percentage values were included in parentheses. DMN, default mode network; MF, medial frontal network; VAs, visual association network; FP, frontoparietal network.

Supplementary Table 3. Individuals with opioid use disorder who reported polysubstance use

	Naturalistic dataset (N=76)	Drug cue dataset (N=70)
Alcohol	59	57
Amphetamines	13	14
Barbiturates	5	4
Cannabis	69	61
Cocaine	67	63
Hallucinogens	31	29
Inhalants	6	6
Other sedatives/hypnotics/tranquilizers	20	21

Supplementary Table 4. State engagement variability during naturalistic stimuli ANOVA covariates

	Sex	Age	Sex-by-group interaction	Age-by-group interaction
Fixation	$F(1,167)=0.065$; $p=0.799$	$F(1,167)=4.202$; $p=0.042$	$F(1,167)=0.001$; $p=0.974$	$F(1,167)=5.326$; $p=0.022$
High-cognition	$F(1,167)=0.566$; $p=0.453$	$F(1,167)=7.173$; $p=0.008$	$F(1,167)=0.003$; $p=0.959$	$F(1,167)=4.193$; $p=0.042$
Low-cognition	$F(1,167)=1.070$; $p=0.303$	$F(1,167)=6.609$; $p=0.011$	$F(1,167)=0.365$; $p=0.546$	$F(1,167)=7.094$; $p=0.008$
Transition	$F(1,167)=0.083$; $p=0.774$	$F(1,167)=9.937$; $p=0.002$	$F(1,167)=0.234$; $p=0.629$	$F(1,167)=3.817$; $p=0.052$

Supplementary Table 5. State engagement variability between rest and cue conditions

	Add 1 lag to time indices	Add 2 lags to time indices
Fixation	t(69)=2.591; p=0.012	t(69)=3.178; p=0.002
High-cognition	t(69)=2.702; p=0.009	t(69)=3.223; p=0.002
Low-cognition	t(69)=5.526; p<0.001	t(69)=6.482; p<0.001
Transition	t(69)=2.724; p=0.008	t(69)=3.423; p=0.001

Supplementary Table 6. State engagement variability during rest condition and cognitive control

	Add 1 lag to time indices		Add 2 lags to time indices	
	ACC Interference	RT Interference	ACC Interference	RT Interference
Fixation	rho=-0.302; p=0.017	rho=-0.272; p=0.034	rho=-0.281; p=0.027	rho=-0.233; p=0.071
High-cognition	rho=-0.244; p=0.057	rho=-0.177; p=0.173	rho=-0.248; p=0.052	rho=-0.157; p=0.227
Low-cognition	rho=-0.089; p=0.490	rho=-0.362; p=0.004	rho=-0.068; p=0.599	rho=-0.334; p=0.009
Transition	rho=-0.394; p=0.002	rho=-0.235; p=0.069	rho=-0.383; p=0.002	rho=-0.228; p=0.077

Supplementary Table 7. State engagement variability during cue condition and cognitive control

	Add 1 lag to time indices		Add 2 lags to time indices	
	ACC Interference	RT Interference	ACC Interference	RT Interference
Fixation	rho=0.031; p=0.811	rho=-0.068; p=0.601	rho=-0.013; p=0.921	rho=-0.034; p=0.797
High-cognition	rho=-6.654e-04; p=0.996	rho=-0.007; p=0.959	rho=-0.013; p=0.923	rho=0.015; p=0.907
Low-cognition	rho=-0.004; p=0.974	rho=-0.006; p=0.962	rho=-0.021; p=0.872	rho=0.025; p=0.847
Transition	rho=-0.011; p=0.931	rho=0.045; p=0.732	rho=-0.045; p=0.727	rho=0.039; p=0.763

Supplementary Table 8. Task activation during the cue paradigm and cognitive control

Node number	ACC Interference			RT Interference		
	r	p	q	r	p	q
1	0.13	0.33	0.89	0.19	0.14	0.99
2	0.05	0.70	0.89	0.18	0.16	0.99
3	0.04	0.75	0.89	0.13	0.34	0.99
4	-0.07	0.60	0.89	0.13	0.33	0.99
5	-0.09	0.49	0.89	0.05	0.73	0.99
6	-0.08	0.55	0.89	0.05	0.67	0.99
7	0.00	0.97	0.91	0.13	0.31	0.99
8	0.05	0.70	0.89	0.04	0.73	0.99
9	-0.15	0.23	0.89	-0.02	0.85	0.99
10	-0.09	0.47	0.89	-0.04	0.76	0.99
11	-0.20	0.11	0.89	0.10	0.46	0.99
12	-0.05	0.71	0.89	0.02	0.86	0.99
13	-0.21	0.10	0.89	-0.09	0.50	0.99
14	0.02	0.87	0.90	0.08	0.53	0.99
15	-0.18	0.16	0.89	0.00	0.98	1.00
16	0.05	0.69	0.89	-0.17	0.20	0.99
17	0.06	0.62	0.89	0.22	0.09	0.99
18	-0.01	0.91	0.90	0.11	0.38	0.99
19	0.04	0.74	0.89	0.06	0.67	0.99
20	-0.09	0.50	0.89	-0.05	0.70	0.99
21	0.05	0.72	0.89	-0.02	0.85	0.99
22	0.21	0.10	0.89	0.01	0.95	1.00
23	0.04	0.75	0.89	-0.07	0.59	0.99
24	0.09	0.50	0.89	0.04	0.75	0.99
25	-0.01	0.93	0.90	-0.06	0.66	0.99
26	-0.05	0.70	0.89	0.17	0.18	0.99
27	0.09	0.48	0.89	-0.01	0.96	1.00

28	-0.15	0.25	0.89	0.08	0.55	0.99
29	0.00	0.99	0.91	0.22	0.10	0.99
30	-0.14	0.28	0.89	0.14	0.30	0.99
31	0.17	0.18	0.89	-0.04	0.74	0.99
32	-0.11	0.40	0.89	0.04	0.76	0.99
33	0.04	0.73	0.89	-0.06	0.64	0.99
34	-0.07	0.58	0.89	0.14	0.29	0.99
35	-0.14	0.27	0.89	0.06	0.66	0.99
36	-0.13	0.33	0.89	-0.04	0.76	0.99
37	0.00	0.98	0.91	-0.05	0.71	0.99
38	-0.19	0.13	0.89	0.03	0.81	0.99
39	0.04	0.78	0.89	-0.07	0.59	0.99
40	-0.05	0.72	0.89	-0.11	0.41	0.99
41	-0.06	0.63	0.89	0.09	0.48	0.99
42	-0.19	0.13	0.89	0.04	0.77	0.99
43	-0.05	0.73	0.89	0.12	0.34	0.99
44	-0.05	0.69	0.89	0.18	0.16	0.99
45	-0.17	0.18	0.89	0.00	0.98	1.00
46	-0.13	0.32	0.89	-0.05	0.72	0.99
47	-0.16	0.21	0.89	0.20	0.12	0.99
48	0.09	0.51	0.89	0.07	0.58	0.99
49	0.04	0.79	0.89	0.13	0.30	0.99
50	-0.02	0.90	0.90	-0.06	0.62	0.99
51	0.02	0.88	0.90	0.00	0.99	1.00
52	0.00	0.97	0.91	0.06	0.63	0.99
53	0.03	0.82	0.89	-0.06	0.67	0.99
54	0.00	0.99	0.91	-0.21	0.11	0.99
55	0.09	0.48	0.89	0.12	0.36	0.99
56	-0.05	0.72	0.89	0.10	0.44	0.99

57	-0.08	0.51	0.89	0.04	0.74	0.99
58	-0.12	0.35	0.89	-0.02	0.85	0.99
59	-0.05	0.70	0.89	-0.03	0.84	0.99
60	-0.12	0.35	0.89	-0.04	0.76	0.99
61	0.03	0.80	0.89	-0.04	0.78	0.99
62	-0.05	0.68	0.89	-0.15	0.24	0.99
63	-0.04	0.76	0.89	-0.10	0.46	0.99
64	-0.09	0.51	0.89	-0.10	0.45	0.99
65	0.05	0.71	0.89	-0.14	0.30	0.99
66	0.03	0.79	0.89	-0.02	0.86	0.99
67	0.22	0.09	0.89	-0.04	0.75	0.99
68	-0.16	0.20	0.89	-0.13	0.32	0.99
69	0.15	0.24	0.89	0.00	0.99	1.00
70	0.06	0.62	0.89	0.03	0.82	0.99
71	0.02	0.90	0.90	-0.03	0.84	0.99
72	0.05	0.70	0.89	0.02	0.86	0.99
73	0.06	0.63	0.89	-0.01	0.92	1.00
74	-0.01	0.92	0.90	-0.12	0.35	0.99
75	0.00	0.99	0.91	0.12	0.37	0.99
76	0.13	0.32	0.89	-0.08	0.55	0.99
77	-0.12	0.34	0.89	-0.04	0.77	0.99
78	0.28	0.03	0.89	0.03	0.83	0.99
79	0.14	0.27	0.89	0.02	0.85	0.99
80	0.02	0.86	0.90	0.14	0.29	0.99
81	0.18	0.17	0.89	0.12	0.37	0.99
82	0.05	0.68	0.89	0.00	0.99	1.00
83	-0.17	0.19	0.89	-0.01	0.93	1.00
84	-0.14	0.27	0.89	0.00	0.99	1.00
85	-0.04	0.79	0.89	0.06	0.65	0.99

86	-0.13	0.30	0.89	-0.08	0.55	0.99
87	-0.05	0.71	0.89	-0.08	0.54	0.99
88	-0.13	0.30	0.89	0.07	0.58	0.99
89	-0.12	0.34	0.89	-0.12	0.36	0.99
90	-0.15	0.24	0.89	0.06	0.67	0.99
91	-0.15	0.25	0.89	0.14	0.28	0.99
92	-0.06	0.67	0.89	0.18	0.16	0.99
93	-0.30	0.02	0.89	0.00	1.00	1.00
94	0.03	0.81	0.89	0.17	0.19	0.99
95	-0.24	0.06	0.89	-0.01	0.95	1.00
96	-0.12	0.34	0.89	-0.10	0.43	0.99
97	-0.04	0.78	0.89	0.14	0.27	0.99
98	-0.08	0.56	0.89	0.00	0.98	1.00
99	-0.01	0.96	0.91	0.14	0.28	0.99
100	0.07	0.61	0.89	0.03	0.83	0.99
101	-0.26	0.04	0.89	0.09	0.51	0.99
102	0.05	0.72	0.89	-0.03	0.85	0.99
103	-0.19	0.15	0.89	0.02	0.91	1.00
104	-0.03	0.79	0.89	0.07	0.60	0.99
105	-0.12	0.37	0.89	0.10	0.46	0.99
106	-0.08	0.54	0.89	0.08	0.52	0.99
107	-0.04	0.76	0.89	0.31	0.02	0.99
108	-0.10	0.44	0.89	0.10	0.46	0.99
109	-0.11	0.37	0.89	0.02	0.91	1.00
110	-0.17	0.19	0.89	0.02	0.90	1.00
111	0.05	0.69	0.89	0.09	0.50	0.99
112	-0.03	0.82	0.89	0.09	0.51	0.99
113	-0.13	0.31	0.89	0.01	0.92	1.00
114	0.05	0.70	0.89	0.11	0.41	0.99

115	-0.11	0.40	0.89	0.10	0.46	0.99
116	-0.12	0.34	0.89	0.06	0.63	0.99
117	-0.20	0.13	0.89	-0.01	0.93	1.00
118	-0.10	0.43	0.89	0.21	0.11	0.99
119	-0.08	0.52	0.89	0.07	0.61	0.99
120	-0.01	0.95	0.91	0.03	0.83	0.99
121	-0.04	0.73	0.89	0.00	0.98	1.00
122	-0.11	0.41	0.89	0.00	1.00	1.00
123	0.04	0.77	0.89	0.16	0.22	0.99
124	-0.05	0.71	0.89	-0.14	0.27	0.99
125	-0.04	0.76	0.89	0.08	0.55	0.99
126	-0.13	0.30	0.89	0.13	0.32	0.99
127	-0.04	0.77	0.89	0.14	0.27	0.99
128	-0.06	0.63	0.89	0.07	0.57	0.99
129	0.10	0.44	0.89	0.19	0.15	0.99
130	0.08	0.53	0.89	0.08	0.56	0.99
131	-0.12	0.34	0.89	-0.08	0.53	0.99
132	-0.24	0.06	0.89	0.02	0.88	1.00
133	-0.17	0.19	0.89	-0.05	0.69	0.99
134	-0.01	0.91	0.90	0.14	0.29	0.99
135	-0.03	0.83	0.90	0.04	0.77	0.99
136	0.23	0.07	0.89	-0.07	0.59	0.99
137	0.05	0.69	0.89	-0.08	0.56	0.99
138	-0.05	0.68	0.89	0.02	0.88	0.99
139	0.05	0.69	0.89	-0.04	0.77	0.99
140	-0.07	0.57	0.89	-0.01	0.92	1.00
141	-0.12	0.34	0.89	-0.03	0.83	0.99
142	-0.09	0.49	0.89	0.01	0.94	1.00
143	0.06	0.62	0.89	-0.04	0.76	0.99
144	-0.13	0.33	0.89	0.06	0.63	0.99
145	-0.18	0.16	0.89	-0.10	0.43	0.99

146	-0.02	0.89	0.90	-0.05	0.70	0.99
147	0.11	0.38	0.89	-0.09	0.50	0.99
148	-0.10	0.46	0.89	-0.19	0.15	0.99
149	-0.06	0.62	0.89	-0.11	0.41	0.99
150	-0.11	0.38	0.89	0.04	0.78	0.99
151	0.14	0.27	0.89	-0.08	0.54	0.99
152	0.04	0.77	0.89	0.11	0.41	0.99
153	-0.04	0.76	0.89	0.06	0.62	0.99
154	0.14	0.27	0.89	0.15	0.23	0.99
155	-0.09	0.48	0.89	-0.01	0.94	1.00
156	0.03	0.84	0.90	-0.01	0.96	1.00
157	0.14	0.29	0.89	-0.04	0.78	0.99
158	0.10	0.45	0.89	-0.05	0.68	0.99
159	0.07	0.61	0.89	-0.04	0.79	0.99
160	-0.08	0.54	0.89	0.09	0.51	0.99
161	-0.17	0.18	0.89	-0.05	0.68	0.99
162	-0.11	0.38	0.89	0.05	0.71	0.99
163	0.03	0.82	0.89	0.08	0.54	0.99
164	-0.13	0.30	0.89	0.11	0.39	0.99
165	0.06	0.67	0.89	-0.02	0.86	0.99
166	-0.05	0.67	0.89	-0.04	0.74	0.99
167	-0.02	0.88	0.90	0.00	1.00	1.00
168	-0.03	0.80	0.89	0.13	0.34	0.99
169	-0.01	0.92	0.90	0.07	0.57	0.99
170	-0.05	0.71	0.89	-0.21	0.10	0.99
171	0.02	0.87	0.90	-0.04	0.78	0.99
172	-0.06	0.62	0.89	-0.04	0.77	0.99
173	-0.05	0.72	0.89	-0.20	0.13	0.99
174	0.00	1.00	0.91	0.05	0.70	0.99

175	-0.01	0.93	0.90	0.07	0.61	0.99
176	-0.20	0.12	0.89	-0.03	0.83	0.99
177	0.11	0.39	0.89	-0.07	0.60	0.99
178	0.00	1.00	0.91	0.20	0.12	0.99
179	-0.03	0.85	0.90	0.02	0.87	0.99
180	-0.11	0.40	0.89	-0.09	0.49	0.99
181	-0.21	0.10	0.89	-0.04	0.77	0.99
182	-0.06	0.66	0.89	-0.03	0.82	0.99
183	-0.02	0.91	0.90	-0.16	0.22	0.99
184	-0.08	0.55	0.89	0.17	0.20	0.99
185	-0.02	0.90	0.90	-0.18	0.16	0.99
186	-0.04	0.74	0.89	-0.04	0.76	0.99
187	-0.07	0.59	0.89	0.02	0.85	0.99
188	0.00	0.99	0.91	0.01	0.96	1.00
189	0.08	0.56	0.89	0.11	0.38	0.99
190	-0.02	0.90	0.90	-0.05	0.69	0.99
191	0.00	0.99	0.91	-0.08	0.52	0.99
192	0.04	0.73	0.89	-0.17	0.19	0.99
193	0.02	0.87	0.90	0.03	0.83	0.99
194	-0.17	0.18	0.89	-0.01	0.91	1.00
195	-0.15	0.26	0.89	0.03	0.79	0.99
196	-0.20	0.11	0.89	0.06	0.62	0.99
197	-0.08	0.53	0.89	-0.04	0.75	0.99
198	0.09	0.48	0.89	-0.04	0.74	0.99
199	0.04	0.75	0.89	0.07	0.61	0.99
200	0.09	0.49	0.89	-0.04	0.73	0.99
201	-0.03	0.80	0.89	0.01	0.95	1.00
202	0.01	0.92	0.90	-0.06	0.63	0.99
203	0.03	0.80	0.89	-0.15	0.25	0.99

204	0.03	0.81	0.89	-0.05	0.72	0.99
205	-0.09	0.49	0.89	-0.09	0.49	0.99
206	0.14	0.28	0.89	-0.02	0.89	1.00
207	0.09	0.46	0.89	0.03	0.85	0.99
208	0.02	0.90	0.90	0.11	0.38	0.99
209	0.04	0.75	0.89	-0.16	0.21	0.99
210	0.10	0.45	0.89	-0.15	0.24	0.99
211	0.13	0.33	0.89	-0.02	0.85	0.99
212	0.27	0.03	0.89	0.09	0.48	0.99
213	0.02	0.89	0.90	0.03	0.80	0.99
214	0.11	0.42	0.89	0.05	0.68	0.99
215	0.07	0.57	0.89	-0.05	0.72	0.99
216	-0.07	0.60	0.89	-0.04	0.79	0.99
217	-0.21	0.10	0.89	0.08	0.53	0.99
218	-0.18	0.15	0.89	-0.10	0.43	0.99
219	-0.19	0.14	0.89	-0.04	0.76	0.99
220	-0.15	0.24	0.89	-0.11	0.38	0.99
221	-0.17	0.19	0.89	0.04	0.78	0.99
222	-0.07	0.61	0.89	-0.22	0.09	0.99
223	-0.07	0.58	0.89	0.03	0.82	0.99
224	-0.21	0.09	0.89	-0.04	0.77	0.99
225	-0.13	0.31	0.89	0.03	0.82	0.99
226	-0.19	0.15	0.89	0.12	0.36	0.99
227	-0.09	0.48	0.89	-0.05	0.72	0.99
228	0.00	0.98	0.91	0.17	0.20	0.99
229	0.07	0.62	0.89	0.03	0.80	0.99
230	-0.01	0.91	0.90	0.08	0.55	0.99
231	-0.04	0.77	0.89	0.21	0.10	0.99
232	0.22	0.09	0.89	0.04	0.75	0.99

233	0.07	0.58	0.89	0.09	0.52	0.99
234	-0.02	0.89	0.90	-0.16	0.23	0.99
235	-0.10	0.46	0.89	0.10	0.46	0.99
236	-0.07	0.58	0.89	0.13	0.32	0.99
237	-0.15	0.23	0.89	0.03	0.80	0.99
238	-0.06	0.66	0.89	0.10	0.45	0.99
239	-0.22	0.09	0.89	0.17	0.20	0.99
240	-0.07	0.56	0.89	0.10	0.43	0.99
241	0.08	0.56	0.89	0.24	0.07	0.99
242	-0.01	0.94	0.91	0.09	0.47	0.99
243	-0.01	0.95	0.91	0.05	0.70	0.99
244	-0.16	0.22	0.89	0.16	0.22	0.99
245	-0.18	0.16	0.89	0.02	0.86	0.99
246	0.01	0.92	0.90	0.15	0.24	0.99
247	-0.07	0.59	0.89	0.08	0.53	0.99
248	-0.04	0.76	0.89	0.09	0.51	0.99
249	-0.03	0.82	0.89	0.15	0.26	0.99
250	-0.17	0.18	0.89	-0.02	0.85	0.99
251	-0.06	0.67	0.89	0.18	0.16	0.99
252	0.05	0.70	0.89	0.28	0.03	0.99
253	0.04	0.75	0.89	0.09	0.47	0.99
254	-0.09	0.47	0.89	0.08	0.56	0.99
255	-0.25	0.05	0.89	0.00	0.99	1.00
256	0.04	0.77	0.89	0.07	0.57	0.99
257	-0.03	0.81	0.89	0.24	0.06	0.99
258	0.10	0.42	0.89	0.24	0.06	0.99
259	-0.08	0.53	0.89	0.11	0.38	0.99
260	-0.03	0.84	0.90	0.04	0.79	0.99
261	0.03	0.79	0.89	-0.12	0.34	0.99

262	0.11	0.39	0.89	0.05	0.68	0.99
263	-0.11	0.41	0.89	0.05	0.69	0.99
264	-0.05	0.72	0.89	0.12	0.37	0.99
265	-0.29	0.02	0.89	0.01	0.92	1.00
266	0.04	0.75	0.89	0.13	0.34	0.99
267	-0.18	0.16	0.89	-0.07	0.60	0.99
268	0.08	0.54	0.89	0.09	0.51	0.99

Supplementary Table 9. Associations between cognitive control and state engagement variability during the first fixation block (i.e., before opioid-related stimulus presentations)

	Accuracy Interference	Response Time Interference
Fixation	rho=-0.024; p=0.852	rho=-0.206; p=0.112
High-cognition	rho=-0.026; p=0.841	rho=-0.094; p=0.470
Low-cognition	rho=-0.068; p=0.601	rho=-0.099; p=0.446
Transition	rho=-0.042; p=0.749	rho=0.221; p=0.087

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