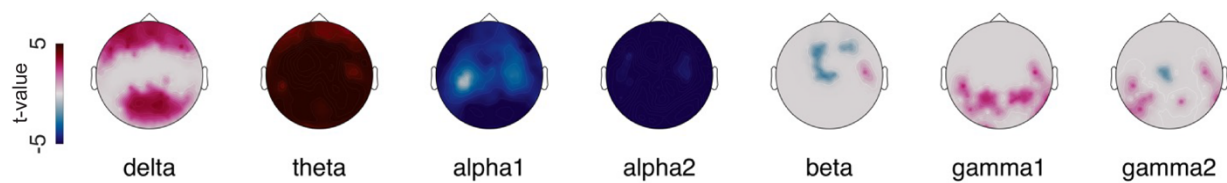


Neocortical Localization and Thalamocortical Modulation of Neuronal Hyperexcitability contribute to Fragile X Syndrome

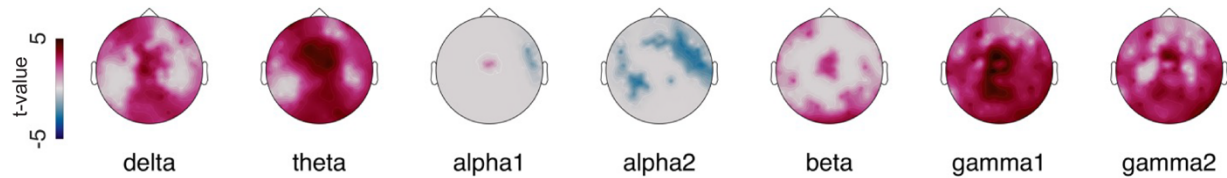
Supplementary Figure 1. Group Contrasts of Topographical Power of Scalp EEG by Frequency Band

Group-level t-maps (5% FDR-corrected) of cluster permutation statistical comparison between FXS (n=70) and TDC (n=71) of scalp (electrode-level) EEG power. As findings across scalp EEG remain spatially ambiguous[1], the findings were primarily used to generate hypotheses and assess for frequency specific trends across groups. Warmer colors indicate significant FXS>TDC, cooler colors indicate significant FXS<TDC, and gray areas indicate non-significant group differences.

a. Relative Power (FXS-TDC)



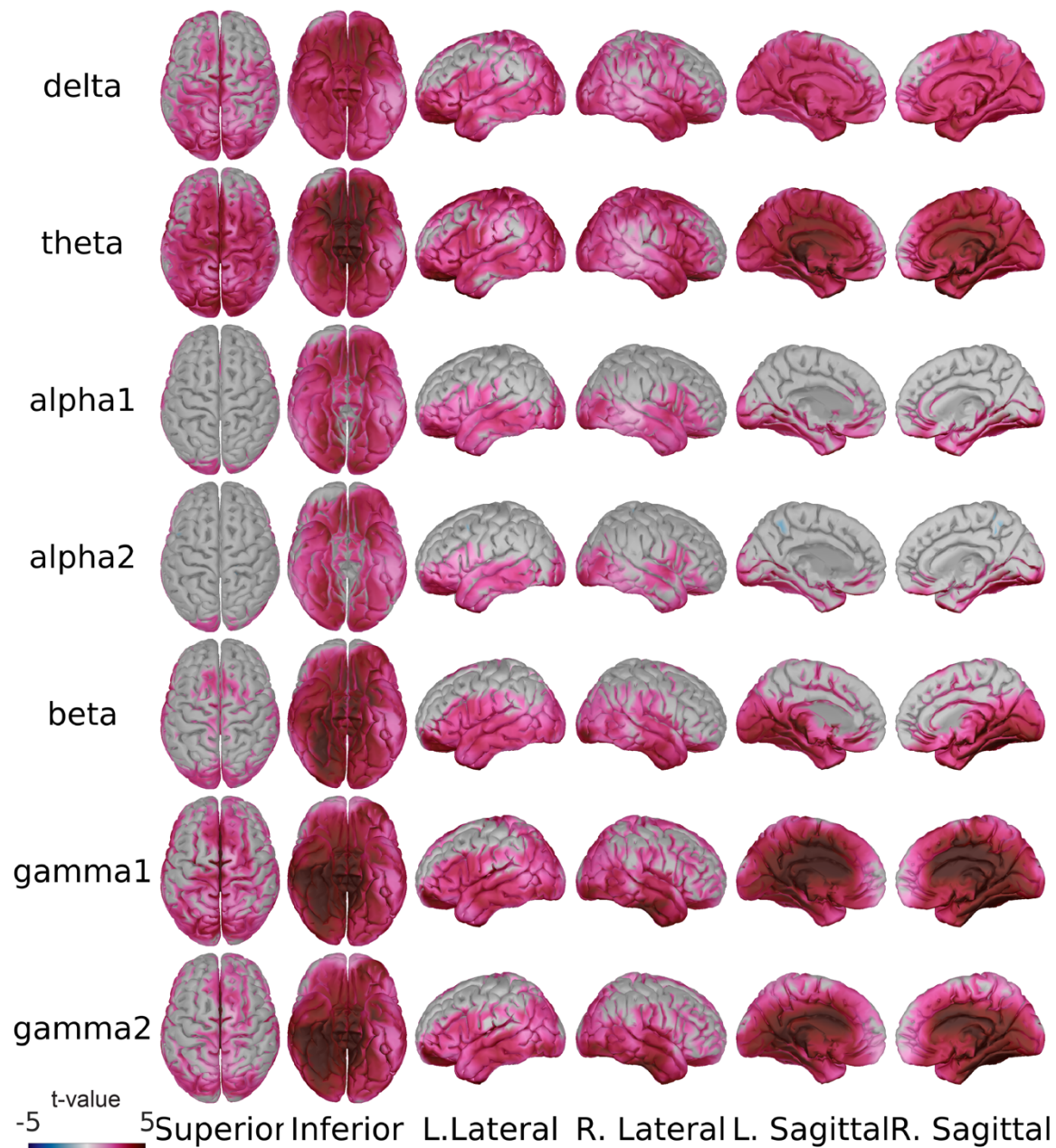
b. Absolute Power (FXS-TDC)



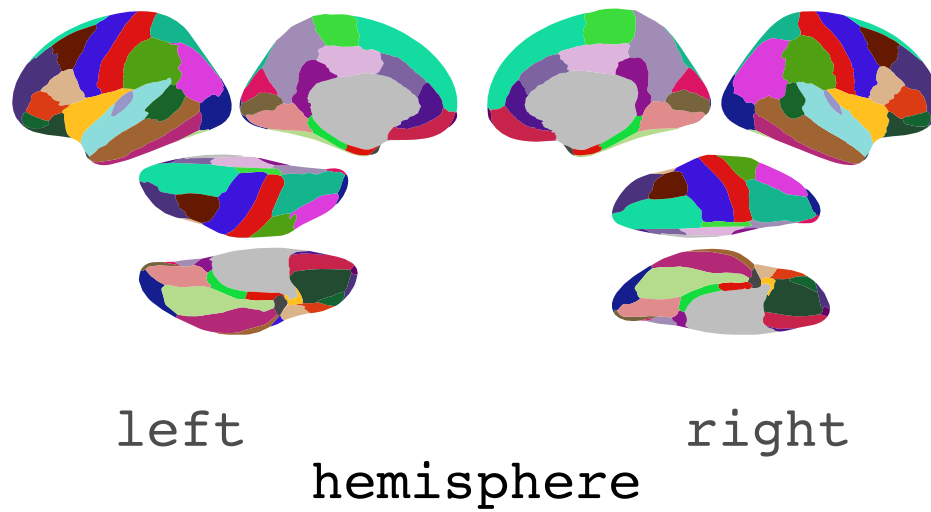
Supplementary Figure 2. Group Contrasts of Source-level Absolute Power by Frequency Band

Group level t-maps depicting FXS – Control, vertex-by-vertex absolute power differences by frequency band superimposed on brain surface models. Warmer (FXS > Control) and cooler (FXS < Control) color scale represents significant t-values (non-significant values as gray).

a. Estimates of absolute power contrasts (FXS-Control)



Supplementary Figure 3. Node-level parcellation key for Desikan-Killiany Cortical Atlas.



Desikan-Killiany Atlas Nodes

	bankssts		pars orbitalis
	caudal anterior cingulate		pars triangularis
	caudal middle frontal		pericalcarine
	corpus callosum		postcentral
	cuneus		posterior cingulate
	entorhinal		precentral
	fusiform		precuneus
	inferior parietal		rostral anterior cingulate
	inferior temporal		rostral middle frontal
	isthmus cingulate		superior frontal
	lateral occipital		superior parietal
	lateral orbitofrontal		superior temporal
	lingual		supramarginal
	medial orbitofrontal		frontal pole
	middle temporal		temporal pole
	parahippocampal		transverse temporal
	paracentral		insula
	pars opercularis		

Supplementary Table 1. Additional Clinical Characteristics by Group

Comparison of detailed demographic and clinical features of EEG dataset by group. FSIQ, Full Scale IQ, NVIQ, Non-verbal intelligence scale; VIQ, verbal intelligence scale; SCQ, Social Communication Questionnaire; WJ-3, Woodcock III Tests of Cognitive Abilities; ABC, Aberrant Behavioral Checklist; ADAMS, Anxiety, Depression, and Mood Scale; t, t-statistic following independent Student t-tests; p, unadjusted significance; adj. p, p-value following Bonferroni correction.

	Control(M)	FXS(M)	Control(F)	FXS(F)	p.overall
	N=41	N=38	N=30	N=32	
Age (Years)	22.2 (9.81)	22.7 (9.95)	22.0 (12.0)	17.9 (9.61)	0.200
FSIQ	106 (10.1)	34.5 (22.8)	99.9 (6.78)	65.5 (29.2)	<0.001
VIQ	108 (13.3)	46.9 (24.2)	97.0 (9.38)	71.7 (27.9)	<0.001
NVIQ	104 (12.2)	22.1 (28.4)	103 (8.65)	59.2 (32.9)	<0.001
SCQ	1.73 (1.93)	17.1 (6.49)	2.65 (2.52)	9.36 (7.00)	<0.001
ABC-Irritability	0.47 (0.97)	11.5 (9.30)	1.12 (2.66)	7.21 (7.87)	<0.001
ABC-Hyperactivity	0.90 (1.21)	18.3 (11.3)	1.25 (4.23)	8.21 (8.02)	<0.001
ABC-Abnormal Speech	0.10 (0.31)	5.88 (3.29)	0.19 (0.75)	2.50 (2.74)	<0.001
ABC-Lethargy	1.30 (3.23)	8.39 (6.76)	0.81 (2.48)	7.50 (8.92)	<0.001
ABC-Stereotypy	0.03 (0.18)	6.30 (5.56)	0.12 (0.50)	1.86 (3.82)	<0.001
ADAMS-OCD	0.23 (0.68)	3.14 (2.66)	0.56 (1.54)	1.29 (1.84)	<0.001
ADAMS-Anxiety	2.03 (2.22)	7.83 (5.01)	2.28 (3.12)	6.37 (5.07)	<0.001
WJ-III	95.3 (13.4)	65.5 (15.8)	91.3 (8.02)	70.9 (15.4)	<0.001

Supplementary Table 2. Preprocessing. Statistical comparison of preprocessing characteristics demonstrating no significant group differences in key artifact cleaning routines across final datasets.

	FXS	Control	p
	<i>N=70</i>	<i>N=71</i>	
Remaining Trials	125 (24.6)	131 (18.1)	0.117
Total Duration(s)	315 (29.0)	311 (25.9)	0.437
Clean Duration(s)	250 (49.2)	262 (36.1)	0.115
Bad Channels	6.27 (3.31)	5.93 (3.71)	0.564
Artifact Components	11.3 (1.71)	10.8 (2.58)	0.117

Supplementary Table 3. Summary of Source-estimated Peak Alpha Frequency (PAF) by Cortical Node. A linear mixed effect model was conducted to examine the effect of group, sex, and cortical node location on source estimated PAF (subject was a random effect). A significant interaction effect between group and node (group x node; $F_{67,9378}=1.44$, $p=0.01$) was present, but no effect of sex. Each row summarizes 5% FDR corrected significant pairwise comparisons (FXS-Control) of PAF estimates (Hz). Atlas key in Appendix 1. Abbreviations: FXS, Fragile X Syndrome; Cont., control; SE, standard error; DF, degrees of freedom; FDR, false discovery rate.

Node	Region	FXS	TDC	FXS-TDC	SE	DF	F	5% FDR
Banks of Sup. Temp. Sulcus R	RT	8.24±.22	9.19±.22	-.95	.30	137	-3.1	0.011
Caudal Anterior Cingulate L	LL	7.96±.22	8.72±.22	-.76	.31	137	-2.5	0.037
Caudal Anterior Cingulate R	RL	7.74±.22	8.61±.22	-.87	.30	137	-2.8	0.017
Caudal Middle Frontal L	LF	8.26±.22	9.29±.22	-1.03	.31	137	-3.4	0.008
Caudal Middle Frontal R	RF	8.39±.22	9.21±.22	-.82	.30	137	-2.7	0.024
Cuneus L	LO	7.86±.22	8.79±.22	-.93	.30	137	-3.1	0.011
Cuneus R	RO	8.45±.22	9.46±.22	-1.01	.30	137	-3.3	0.009
Entorhinal L	LT	7.61±.22	8.34±.22	-.73	.30	137	-2.4	0.045
Fusiform R	RT	8.54±.22	9.28±.22	-.74	.30	137	-2.4	0.041
Inferior Parietal L	LP	8.30±.22	9.26±.22	-.97	.30	137	-3.2	0.011
Insula L	LT	8.29±.22	9.19±.22	-.91	.30	137	-3.0	0.012
Isthmus Cingulate L	LL	8.40±.22	9.33±.22	-.93	.30	137	-3.0	0.011
Isthmus Cingulate R	RL	8.27±.22	9.26±.22	-.99	.30	137	-3.3	0.010
Lateral Occipital L	LO	8.22±.22	9.13±.22	-.92	.30	137	-3.0	0.011
Paracentral L	LC	8.88±.22	9.60±.22	-.72	.30	137	-2.4	0.045
Paracentral R	RC	8.68±.22	9.46±.22	-.78	.30	137	-2.5	0.034
Pars Opercularis L	LF	7.79±.22	8.51±.22	-.72	.30	137	-2.4	0.045
Pars Triangularis R	RF	7.68±.22	8.79±.22	-1.12	.30	137	-3.7	0.004
Postcentral L	LC	8.25±.22	9.48±.22	-1.23	.30	137	-4.0	0.002
Postcentral R	RC	8.31±.22	9.23±.22	-.92	.30	137	-3.0	0.011
Posteriorcingulate L	LL	8.23±.22	9.17±.22	-.94	.31	137	-3.1	0.011
Posteriorcingulate R	RL	8.00±.22	8.95±.22	-.95	.31	137	-3.1	0.011
Precentral L	LC	8.19±.22	9.62±.22	-1.43	.30	137	-4.7	<0.001
Precentral R	RC	8.51±.22	9.26±.22	-.75	.31	137	-2.4	0.041
Precuneus L	LP	8.07±.22	9.34±.22	-1.27	.30	137	-4.2	0.001
Precuneus R	RP	8.31±.22	9.10±.22	-.79	.30	137	-2.6	0.033
Superior Parietal L	LP	8.11±.22	9.26±.22	-1.15	.30	137	-3.8	0.003
Superior Parietal R	RP	7.85±.22	9.21±.22	-1.36	.30	137	-4.5	<0.001
Supramarginal L	LP	8.72±.22	9.82±.22	-1.10	.30	137	-3.6	0.004
Supramarginal R	RP	8.34±.22	9.30±.22	-.95	.30	137	-3.1	0.011

Supplementary Table 4. Pairwise group differences of gamma1 cross-frequency coupling by cortical node.

Pairwise (FXS-Control) gamma1 power-power CFC comparisons by cortical node						
Node	Theta		Alpha1		Alpha2	
	L	R	L	R	L	R
Banks of Sup. Temp. Sulcus	-.08*	-.12***	.06*	.06*	.10**	.06*
Caudal Anterior Cingulate	-.11**	-.11**	.02	.02	.08*	.08*
Caudal Middle Frontal	-.11**	-.11***	.03	.03	.07*	.05
Cuneus	-.05*	-.09*	.06*	.08*	.09*	.12***
Entorhinal	-.08*	-.05	.06*	.08*	.08*	.10**
Frontal Pole	.02	.01	.05*	.06*	.06*	.06*
Fusiform	-.06*	-.07*	.08*	.09*	.09*	.12***
Inferior Parietal	-.08*	-.11**	.04	.07*	.10**	.08*
Inferior Temporal	-.08*	-.07*	.04	.09*	.07*	.10**
Insula	-.08*	-.05*	.04	.03	.05	.07*
Isthmus Cingulate	-.12***	-.13***	.10**	.11**	.15***	.12***
Lateral Occipital	-.03	-.05*	.08*	.07*	.09*	.09*
Lateral Orbitofrontal	-.01	-.04	.11**	.06*	.10**	.09**
Lingual	-.03	-.04	.12***	.09*	.08*	.09**
Medial Orbitofrontal	-.01	-.05	.08*	.06*	.08*	.08*
Middle Temporal	-.06*	-.06*	.07*	.07*	.07*	.10**
Paracentral	-.12***	-.12***	.04	.03	.12***	.11***
Parahippocampal	-.08*	-.09*	.09**	.09**	.09**	.11**
Pars Opercularis	-.06*	-.03	.02	.05	.06*	.05*
Pars Orbitalis	-.02	.03	.07*	.03	.08*	.05
Pars Triangularis	-.05*	-.06*	.04	.01	.07*	.06*
Pericalcarine	-.03	-.04	.11**	.09**	.08*	.07*
Postcentral	-.12***	-.10**	.06*	.05	.07*	.05*
Posteriorcingulate	-.13***	-.13***	.04	.05	.10**	.09*
Precentral	-.11***	-.13***	.06*	.05	.06*	.08*
Precuneus	-.12***	-.14***	.09*	.06*	.10**	.11***
Rostral Anterior Cingulate	-.03	-.03	.07*	.06*	.06*	.07*
Rostral Middle Frontal	-.03	-.04	.06*	.02	.06*	.05*
Superior Frontal	-.09**	-.08*	.01	-.02	.07*	.07*
Superior Parietal	-.13***	-.13***	.09*	.09*	.07*	.11**
Superior Temporal	-.07*	-.06*	.05	.06*	.06*	.09*
Supramarginal	-.11**	-.10**	.05*	.04	.08*	.06*
Temporal Pole	-.04	-.05	.05	.08*	.05*	.10**
Transverse Temporal	-.08*	-.08*	.07*	.05*	.07*	.09**

Supplementary Table 5. Pairwise group differences of gamma1 cross-frequency coupling by resting state network (RSN).

RSN	Lower Band	Estimate	Statistic	DF	5% FDR p	Sig.
DMN	theta	-.08±.01	-6.26	139	1.6e-08	***
	alpha1	.07±.01	5.62	139	2.3e-07	***
	alpha2	.09±.01	7.34	139	2.9e-10	***
DAN	theta	-.05±.01	-3.91	139	2.0e-04	***
	alpha1	.05±.01	3.48	139	8.1e-04	***
	alpha2	.07±.01	5.41	139	5.4e-07	***
SAN	theta	-.08±.01	-5.64	139	2.3e-07	***
	alpha1	.04±.01	2.65	139	9.0e-03	**
	alpha2	.06±.01	4.37	139	3.9e-05	***
AUD	theta	-.07±.02	-3.41	139	9.6e-04	***
	alpha1	.05±.02	2.82	139	5.8e-03	**
	alpha2	.08±.02	3.96	139	1.8e-04	***
VIS	theta	-.05±.01	-3.79	139	2.9e-04	***
	alpha1	.08±.01	5.86	139	9.6e-08	***
	alpha2	.09±.01	6.80	139	2.6e-09	***
other	theta	-.08±.01	-6.49	139	8.5e-09	***
	alpha1	.06±.01	4.65	139	1.4e-05	***
	alpha2	.08±.01	6.38	139	1.1e-08	***

Supplementary Table 6. Age-corrected Clinical Correlations of Spectral Power by Cortical Region

Abbreviations: See Appendix 2 for region atlas key; ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale; SCQ, Social Communication Questionnaire; VIQ, verbal intelligence quotient.

All FXS Participants

Measure	Frequency	Region	Spearman's ρ			Age-Corrected	
			n	rho	adj.p	rho	adj.p
ABC-Abnormal Speech	alpha1	LPF	61	-.44	0.01	-.48	<0.01
		RPF	61	-.40	0.03	-.44	0.02
ABC-Hyperactivity	alpha2	LPF	61	-.35	0.05	-.38	0.04
	alpha1		61	-.42	0.02	-.40	0.03
		LT	61	-.46	0.01	-.44	0.02
		RPF	61	-.44	0.01	-.42	0.02
ABC-Stereotypy	theta	RT	61	-.49	<0.01	-.48	<0.01
		LPF	61	-.40	0.03	-.40	0.03
		RPF	61	-.39	0.03	-.39	0.04
		LO	61	-.30	0.1	-.39	0.04
	alpha1	LPF	61	-.47	<0.01	-.49	<0.01
		LT	61	-.32	0.08	-.39	0.04
		RO	61	-.33	0.07	-.41	0.03
		RPF	61	-.48	<0.01	-.50	<0.01
		RT	61	-.38	0.04	-.45	0.01
		LPF	61	-.44	0.01	-.46	0.01
		RO	61	-.32	0.08	-.39	0.04
		RPF	61	-.39	0.03	-.41	0.03
ADAMS-OCD	alpha1	LO	64	-.39	0.03	-.42	0.02
		LP	64	-.36	0.04	-.39	0.03
		LPF	64	-.39	0.03	-.39	0.03
		LT	64	-.44	0.01	-.47	<0.01
		RO	64	-.36	0.05	-.38	0.04
		RP	64	-.36	0.04	-.39	0.03
		RPF	64	-.43	0.01	-.44	0.02
		RT	64	-.45	<0.01	-.48	<0.01
	alpha2	LC	64	-.39	0.03	-.39	0.03
		LL	64	-.49	<0.01	-.49	<0.01
		LP	64	-.40	0.03	-.42	0.02
		LPF	64	-.45	<0.01	-.45	0.01
		LT	64	-.40	0.02	-.42	0.02
		RC	64	-.40	0.02	-.40	0.03
		RL	64	-.48	<0.01	-.48	<0.01
		RP	64	-.42	0.02	-.43	0.02
		RPF	64	-.44	0.01	-.44	0.01
		RT	64	-.42	0.02	-.44	0.02
SCQ	alpha1	LPF	62	-.46	<0.01	-.48	<0.01
		LT	62	-.35	0.06	-.41	0.03
		RPF	62	-.46	<0.01	-.49	<0.01
		RT	62	-.33	0.07	-.39	0.04
	alpha2	LF	62	-.38	0.03	-.39	0.04
		LL	62	-.40	0.03	-.42	0.02
		LPF	62	-.51	<0.01	-.52	<0.01
		RC	62	-.36	0.05	-.37	0.05
		RL	62	-.40	0.03	-.43	0.02
		RPF	62	-.47	<0.01	-.49	<0.01
VIQ	alpha1	LPF	64	.35	0.05	.40	0.03

Supplementary Table 7. Age-corrected Clinical Correlations of Spectral Power by Cortical Region

Abbreviations: See Appendix 2 for region atlas key; ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale; SCQ, Social Communication Questionnaire; WJ-3, Woodcock-Johnson III Tests of Cognitive Abilities, Auditory Attention subscale; NVIQ, non-verbal intelligence quotient; VIQ, verbal intelligence quotient.

Full mutation, non-mosaic males with FXS only

Measure	Frequency	Region	Spearman's ρ			Age-Corrected	
			n	ρ	p	ρ	p
ABC-Abnormal Speech	theta	LPF	24	-.48	0.02	-.50	0.01
		RPF	24	-.48	0.02	-.49	0.02
	alpha1	LPF	24	-.50	0.01	-.49	0.02
		RPF	24	-.44	0.03	-.42	0.05
	gamma1	LPF	24	.36	0.08	.42	0.05
		RF	24	.46	0.03	.50	0.02
		RL	24	.44	0.03	.46	0.03
		RP	24	.46	0.02	.49	0.02
	gamma2	RPF	24	.46	0.02	.50	0.02
		RT	24	.39	0.06	.47	0.02
		LL	24	.43	0.04	.48	0.02
		LPF	24	.38	0.07	.45	0.03
		RC	24	.39	0.06	.45	0.03
		RL	24	.44	0.03	.47	0.02
		RP	24	.57	<0.01	.60	<0.01
		RPF	24	.54	<0.01	.58	<0.01
		RT	24	.54	<0.01	.59	<0.01
ABC-Hyperactivity	gamma1	LF	24	.08	0.72	.43	0.04
		RP	24	.26	0.23	.42	0.04
ABC-Irritability			24	.34	0.1	.42	0.04
ABC-Lethargy	theta	LPF	24	-.46	0.02	-.48	0.02
		RPF	24	-.49	0.02	-.49	0.02
	alpha1	LPF	24	-.46	0.02	-.45	0.03
		RPF	24	-.53	<0.01	-.51	0.01
	alpha2	LPF	24	-.46	0.02	-.44	0.04
		RPF	24	-.51	0.01	-.49	0.02
ABC-Stereotypy	gamma1	LF	24	.33	0.11	.43	0.04
	theta	LC	24	-.33	0.12	-.41	0.05
		LF	24	-.40	0.05	-.49	0.02
		LPF	24	-.53	<0.01	-.60	<0.01
		RC	24	-.33	0.11	-.45	0.03
		RP	24	-.30	0.15	-.43	0.04
		RPF	24	-.55	<0.01	-.59	<0.01
		RT	24	-.40	0.06	-.43	0.04
		LPF	24	-.64	<0.01	-.66	<0.01
	alpha1	RO	24	-.51	0.01	-.43	0.04
		RPF	24	-.62	<0.01	-.62	<0.01
		LPF	24	-.56	<0.01	-.55	<0.01
	alpha2	RPF	24	-.51	0.01	-.48	0.02
ADAMS-Anxiety	alpha1		27	-.48	0.01	-.46	0.02
		RT	27	-.45	0.02	-.39	0.05

Measure	Frequency	Region	Spearman's ρ			Age-Corrected	
			n	rho	p	rho	p
ADAMS-OCD	alpha2	LO	27	-.49	<0.01	-.43	0.03
		LPF	27	-.49	<0.01	-.47	0.02
		LT	27	-.58	<0.01	-.54	<0.01
		RO	27	-.60	<0.01	-.56	<0.01
		RPF	27	-.48	0.01	-.46	0.02
	alpha1	RT	27	-.48	0.01	-.42	0.03
		LO	27	-.53	<0.01	-.45	0.02
		LT	27	-.56	<0.01	-.48	0.01
		RO	27	-.47	0.01	-.40	0.04
		RT	27	-.52	0.01	-.49	0.02
NVIQ	alpha2	LT	22	-.50	0.02	-.46	0.04
	gamma1	LP	22	-.45	0.04	-.44	0.04
		LT	22	-.51	0.01	-.48	0.03
		RO	22	-.62	<0.01	-.60	<0.01
		RT	22	-.52	0.01	-.49	0.02
	gamma2	LP	22	-.47	0.03	-.46	0.04
		LT	22	-.53	0.01	-.51	0.02
		RO	22	-.59	<0.01	-.57	<0.01
		RT	22	-.55	<0.01	-.54	0.01
		RPF	24	-.44	0.03	-.43	0.04
SCQ	alpha1	RPF	24	-.49	0.01	-.46	0.03
VIQ	alpha2	LT	22	-.30	0.17	-.57	<0.01
		RT	22	-.25	0.26	-.46	0.04
WJ-III	theta	LO	23	.32	0.14	.45	0.04
		LP	23	.42	0.05	.46	0.03
		RO	23	.31	0.15	.45	0.04
		RP	23	.38	0.07	.52	0.01
		LO	23	.60	<0.01	.52	0.01
	alpha1	LO	23	-.17	0.44	-.43	0.05
		RP	23	-.41	0.05	-.49	0.02
	gamma1	LO	23	-.22	0.31	-.48	0.02
		RO	23	-.29	0.18	-.43	0.04
		RP	23	-.41	0.05	-.49	0.02

Supplementary Table 8. Age-corrected Clinical Correlations of Spectral Power by Resting State Network (RSN)

Abbreviations: ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale; SCQ, Social Communication Questionnaire; WJ-3, Woodcock-Johnson III Tests of Cognitive Abilities, Auditory Attention subscale; Map, RSN or region label; DMN, default mode network; DAN, dorsal attention network; SAN, salient affective network; VIS, visual attention network; AUD, auditory network.

All FXS Participants

Measure	Frequency	Spearman's ρ				Age-Corrected	
		RSN	n	rho	adj.p	rho	adj.p
ABC-Abnormal Speech	gamma2	SAN	61	.38	0.03	.36	0.05
ABC-Hyperactivity	alpha1	AUD	61	-.46	0.01	-.44	0.02
		DAN	61	-.42	0.02	-.40	0.03
ABC-Stereotypy	theta	AUD	61	-.38	0.03	-.38	0.04
			61	-.36	0.03	-.40	0.03
	alpha1	DAN	61	-.36	0.03	-.39	0.03
		VIS	61	-.36	0.03	-.44	0.02
		DAN	61	-.34	0.04	-.37	0.04
		DMN	61	-.34	0.04	-.39	0.03
		VIS	61	-.30	0.08	-.38	0.04
ADAMS-OCD	alpha1	AUD	64	-.45	0.01	-.46	0.02
		DAN	64	-.38	0.03	-.38	0.03
		DMN	64	-.39	0.02	-.41	0.03
		VIS	64	-.39	0.02	-.42	0.02
	alpha2	AUD	64	-.41	0.02	-.42	0.02
		DAN	64	-.38	0.03	-.38	0.03
		DMN	64	-.50	<0.01	-.52	<0.01
		SAN	64	-.41	0.02	-.42	0.02
		VIS	64	-.33	0.04	-.36	0.05
SCQ	alpha1	AUD	62	-.32	0.05	-.36	0.05
		DAN	62	-.37	0.03	-.40	0.03
		DMN	62	-.34	0.04	-.40	0.03
		SAN	62	-.33	0.05	-.36	0.05
	alpha2	DAN	62	-.36	0.03	-.39	0.03
		DMN	62	-.39	0.03	-.44	0.02
		SAN	62	-.39	0.02	-.41	0.03
WJ-III	alpha1		58	.37	0.03	.39	0.03

Supplementary Table 9. Age-corrected Clinical Correlations of Spectral Power by Resting State Network

Abbreviations: ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale; WJ-3, Woodcock-Johnson III Tests of Cognitive Abilities, Auditory Attention subscale; NVIQ, non-verbal intelligence quotient; Map, RSN or region label; DMN, default mode network; DAN, dorsal attention network; SAN, salient affective network; VIS, visual attention network; AUD, auditory network.

Full mutation, non-mosaic males with FXS only

Measure	Frequency	Spearman's ρ				Age-Corrected	
		Rsn	n	rho	p	rho	p
ABC-Abnormal Speech	alpha2	SAN	24	.37	0.08	.51	0.01
		AUD	24	.34	0.1	.43	0.04
	gamma1	DAN	24	.42	0.04	.51	0.01
		DMN	24	.39	0.06	.43	0.04
		SAN	24	.40	0.05	.45	0.03
	gamma2	AUD	24	.44	0.03	.49	0.02
		DAN	24	.46	0.02	.53	<0.01
		DMN	24	.46	0.02	.51	0.01
	theta	AUD	24	-.41	0.05	-.45	0.03
ABC-Lethargy			24	-.37	0.08	-.47	0.02
ABC-Stereotypy		DAN	24	-.38	0.07	-.43	0.04
		DMN	24	-.46	0.02	-.46	0.03
		SAN	24	-.39	0.06	-.47	0.03
	alpha1	DAN	24	-.47	0.02	-.44	0.04
ADAMS-Anxiety	alpha2	VIS	27	-.55	<0.01	-.51	<0.01
ADAMS-OCD	alpha1	AUD	27	-.49	<0.01	-.44	0.03
		VIS	27	-.51	<0.01	-.41	0.04
NVIQ	alpha2	DMN	27	-.50	<0.01	-.40	0.04
	gamma1	AUD	22	-.49	0.02	-.45	0.04
		DAN	22	-.48	0.02	-.44	0.04
		DMN	22	-.47	0.03	-.46	0.04
		VIS	22	-.63	<0.01	-.60	<0.01
	gamma2	AUD	22	-.54	<0.01	-.52	0.02
		DMN	22	-.45	0.03	-.44	0.05
		VIS	22	-.53	0.01	-.50	0.02
WJ-III	gamma1		23	-.23	0.3	-.42	0.05
	gamma2		23	-.25	0.25	-.44	0.04

Supplementary Table 10. Age-corrected Clinical Correlations of Peak Alpha Frequency (PAF) by Resting State Network (RSN) in All FXS Participants (trending significance following FDR correction).

Abbreviations: VIQ, verbal intelligence quotient; SAN, salient affective network.

Measure	RSN	Type	r	p	adj. p	n
VIQ	SAN	PAF	.39	1.5e-03	0.081	64

Supplementary Table 11. Age-corrected Clinical Correlations of Peak Alpha Frequency (PAF) by Cortical Region in full mutation, non-mosaic males with FXS.

Abbreviations: ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale. Cortical regions include occipital (O), Limbic (L), parietal (P), temporal (T), central (C), frontal (F), and prefrontal (PF) each with a preceding right (R) or left (L) designation.

Measure	Spearman's ρ				Age-Corrected	
	Region	n	rho	p	rho	p
ABC-Hyperactivity	LC	24	.14	0.53	.42	0.05
	LF	24	-.50	0.01	-.48	0.02
	LO	24	-.54	<0.01	-.42	0.05
ABC-Stereotypy		24	-.54	<0.01	-.45	0.03
	RPF	24	.54	<0.01	.54	<0.01
ADAMS-Anxiety	LO	27	-.57	<0.01	-.53	<0.01
	LPF	27	-.48	0.01	-.43	0.03
	LT	27	-.53	<0.01	-.53	<0.01
	RP	27	-.42	0.03	-.41	0.04
	RT	27	-.42	0.03	-.46	0.02

Supplementary Table 12. Age-corrected Clinical Correlations of Peak Alpha Frequency (PAF) by Resting State Network (RSN) in full mutation, non-mosaic males with FXS.

Abbreviations: ADAMS, Anxiety, Depression and Mood Scale; DMN, Default Mode Network.

Measure	RSN	n	Spearman's ρ		Age-Corrected	
			rho	p	rho	p
ADAMS-Anxiety	DMN	27	-.44	0.02	-.46	0.02

Supplementary Table 13. Age-corrected Clinical Correlations of Power-Power Cross-frequency Coupling (CFC) by Cortical Region in full mutation, non-mosaic males with FXS. No significant correlations were present across all FXS participants following FDR correction.

Abbreviations: ABC, Aberrant Behavior Checklist; ADAMS, Anxiety, Depression and Mood Scale; NVIQ, non-verbal intelligence quotient; VIQ, verbal intelligence quotient; WJ-III, Woodcock Johnson III Test of Auditory Attention. Cortical regions include occipital (O), Limbic (L), parietal (P), temporal (T), central (C), frontal (F), and prefrontal (PF) each with a preceding right (R) or left (L) designation.

Measure	Frequency	Region	Spearman's ρ			Age-Corrected	
			n	rho	p	rho	p
ADAMS-Anxiety	alpha1	RO	27	.43	0.02	.44	0.03
ADAMS-OCD	theta		27	.40	0.04	.39	0.05
	alpha1		27	.40	0.04	.42	0.03
NVIQ	theta	LF	22	.49	0.02	.45	0.04
		LT	22	.55	<0.01	.51	0.02
	alpha1	RO	22	.58	<0.01	.58	<0.01
		RT	22	.60	<0.01	.58	<0.01
	alpha2	RO	22	.44	0.04	.44	0.04
		RP	22	.42	0.05	.44	0.04
		RT	22	.56	<0.01	.55	<0.01
VIQ	alpha1	LT	22	-.53	0.01	-.50	0.02
	alpha2		22	-.56	<0.01	-.55	<0.01
WJ-III		RC	23	.42	0.05	.47	0.03

Supplementary Table 14. Age-corrected Clinical Correlations of Power-Power Cross-frequency Coupling (CFC) by Resting State Network (RSN) in full mutation, non-mosaic males with FXS. No significant correlations were present across all FXS participants following FDR correction.

Abbreviations: ADAMS, Anxiety, Depression and Mood Scale; OCD, obsessive compulsive disorder; NVIQ, non-verbal intelligence quotient. Resting state networks include default mode network (DMN), dorsal attention network (DAN), salient affective network (SAN), auditory network (AUD), and visual network (VIS).

Measure	Frequency	Spearman's ρ				Age-Corrected	
		Rsn	n	rho	p	rho	p
ADAMS-Anxiety	alpha1	VIS	27	.42	0.03	.41	0.04
ADAMS-OCD	alpha2		27	.38	0.05	.40	0.04
NVIQ	theta	DAN	22	.47	0.03	.44	0.05
		SAN	22	.52	0.01	.49	0.03
	alpha1	AUD	22	.48	0.02	.46	0.04
		DAN	22	.54	<0.01	.53	0.01
		VIS	22	.45	0.03	.44	0.04
	alpha2	DAN	22	.48	0.02	.46	0.04

Supplementary Table 15. Assignment of cortical nodes to region and resting state network (RSN) groups as attributed by the Desikan-Killiany (DK) atlas. The MNI coordinates and number of vertices included in each node parcel are also displayed. Region and RSN represents an anatomical and functional grouping strategy for cortical nodes respectively.

Abbreviations: RSN, resting state networks; DMN, default mode network; DAN, dorsal attention network; SAN, salience affective network; VIS, visual network; other, unassigned nodes. L, Left; R, right; F, frontal; L, limbic; O, occipital; P, parietal; PF, prefrontal; T, temporal.

RSN	Node	Abbreviation	Cortex	MNI Centroid			Vert.
				x	y	z	
DMN	Caudal Anterior Cingulate R	cACC R	RL	4	22	27	68
	Isthmus Cingulate L	iCC L	LL	-7	-45	18	81
	Isthmus Cingulate R	iCC R	RL	6	-42	19	91
	Lateral Orbitofrontal L	LOF L	LPF	-25	30	-19	221
	Lateral Orbitofrontal R	LOF R	RPF	23	32	-19	206
	Medial Orbitofrontal L	MOF L	LPF	-7	33	-17	155
	Medial Orbitofrontal R	MOF R	RPF	4	37	-15	170
	Parahippocampal L	paraH L	LT	-26	-29	-21	68
	Parahippocampal R	paraH R	RT	24	-30	-19	66
	Posterior Cingulate L	PCC L	LL	-5	-15	38	85
	Posterior Cingulate R	PCC R	RL	5	-17	39	93
	Precuneus L	PCUN L	LP	-9	-59	38	314
	Precuneus R	PCUN R	RP	10	-58	38	325
	Rostral Anterior Cingulate L	rACC L	LL	-5	39	1	78
	Rostral Anterior Cingulate R	rACC R	RL	4	38	3	56
SAN	Caudal Middle Frontal L	cMFG L	LF	-37	11	47	224
	Caudal Middle Frontal R	cMFG R	RF	37	13	48	186
	Insula L	INS L	LT	-38	-2	2	174
	Insula R	INS R	RT	36	2	-2	196
	Rostral Middle Frontal L	rMFG L	LF	-34	47	17	543
	Rostral Middle Frontal R	rMFG R	RF	34	48	17	551
	Supramarginal L	SMAR L	LP	-57	-38	34	305
	Supramarginal R	SMAR R	RP	54	-31	36	302
DAN	Caudal Anterior Cingulate L	cACC L	LL	-5	21	26	48
	Inferior Temporal L	ITG L	LT	-53	-36	-22	307
	Inferior Temporal R	ITG R	RT	51	-32	-25	316
	Middle Temporal L	MTG L	LT	-58	-23	-15	277
	Middle Temporal R	MTG R	RT	58	-22	-15	324
	Pars Opercularis L	pOPER L	LF	-49	17	14	139
	Pars Opercularis R	pOPER R	RF	49	17	14	118
	Pars Orbitalis L	pORB L	LPF	-44	39	-14	72
	Pars Orbitalis R	pORB R	RPF	43	42	-15	68
	Pars Triangularis L	pTRI L	LF	-47	32	1	101
	Pars Triangularis R	pTRI R	RF	48	34	2	148
AUD	Superior Temporal L	STG L	LT	-55	-12	-4	290
	Superior Temporal R	STG R	RT	54	-6	-7	257
VIS	Cuneus L	CUN L	LO	-6	-80	19	93
	Cuneus R	CUN R	RO	8	-78	20	99
	Fusiform L	FUS L	LT	-36	-43	-22	268
	Fusiform R	FUS R	RT	35	-41	-23	255

RSN	Node	Abbreviation	Cortex	MNI Centroid			Vert.
				x	y	z	
other	Lateral Occipital L	LOG L	LO	-31	-89	0	371
	Lateral Occipital R	LOG R	RO	35	-85	2	367
	Lingual L	LING L	LO	-14	-71	-5	246
	Lingual R	LING R	RO	13	-67	-4	227
	Banks of Sup. Temp. Sulcus L	BSTS L	LT	-53	-45	8	76
	Banks of Sup. Temp. Sulcus R	BSTS R	RT	54	-41	10	70
	Entorhinal L	ENT L	LT	-26	-5	-33	30
	Entorhinal R	ENT R	RT	23	-6	-35	32
	Frontal Pole L	FP L	LPF	-7	68	-11	22
	Frontal Pole R	FP R	RPF	7	68	-15	30
	Inferior Parietal L	IPL L	LP	-42	-71	32	351
	Inferior Parietal R	IPL R	RP	46	-63	32	421
	Paracentral L	paraC L	LC	-7	-30	57	110
	Paracentral R	paraC R	RC	7	-27	57	128
	Pericalcarine L	periCAL L	LO	-11	-82	6	109
	Pericalcarine R	periCAL R	RO	12	-80	7	110
	Postcentral L	postC L	LC	-46	-22	45	333
	Postcentral R	postC R	RC	44	-20	46	307
	Precentral L	preC L	LC	-41	-9	46	339
	Precentral R	preC R	RC	40	-7	46	353
	Superior Frontal L	sFG L	LF	-12	30	41	671
	Superior Frontal R	sFG R	RF	12	32	41	603
	Superior Parietal L	SPL L	LP	-23	-65	50	484
	Superior Parietal R	SPL R	RP	24	-65	51	464
	Temporal Pole L	TP L	LT	-28	14	-38	38
	Temporal Pole R	TP R	RT	27	16	-36	38
	Transverse Temporal L	TT L	LT	-46	-23	10	34
	Transverse Temporal R	TT R	RT	46	-17	9	23

Supplementary References

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