Table S1. Clinical characteristics of GAD-LE patients.

Patient	Gender	Laterali-zation	Age at onset, yrs	Age at 1st visit, yrs	Age at study, yrs	# of AEDs at study	Ab at 1st visit	Ab at study	Initial IT	IT at study	Verbal memory at study	Figural memory at study	Clinical MRI at 1st visit	Clinical MRI at study
1	F	L	46.4	48.4	52.6	2	>1000U/ml	NA	MPR pulse	None	88	92	uWML	uWML
2	F	R + L	16.5	18.0	21.6	2	>1000U/ml	>1000U/ml	MPR pulse	MMF	105	73	HI AMR+HCR + claustrum bilateral	HI+A HCR
3	M	R + L	26.4	26.7	29.9	2	>1000U/ml	>1000U/ml	MPR pulse	None	100	104	HI AML	Normal
4	F	R	30.0	32.0	32.1	2	>1000U/ml	>1000U/ml	IVIG	None	103	102	Normal	Normal
5	F	R + L	21.0	25.7	28.4	2	>1000U/ml	>1000U/ml	IVIG	PR oral	109	97	HI+A HCL	HI+A HCL
6	F	R	18.1	18.2	20.6	2	>1000U/ml	0U/ml	MPR pulse	None	85	66	HI+VI AMR+HCR, HI biparietal+ thalamus bilateral	HI HCR
7	M	L	29.3	35.0	35.0	2	>1000U/ml	>1000U/ml	AZA	None	107	108	Normal	Normal
8	M	L	43.0	43.3	43.5	1	>1000U/ml	>1000U/ml	PR oral	MPR pulse+ PR oral	92	106	HI AML+HCL	HI AML+HCL
9	F	L	48.7	49.1	50.1	1	>1000U/ml	>1000U/ml	MPR pulse	None	107	84	HI+VI AMR	HI AMR
10	F	L	28.5	28.6	28.6	1	>1000U/ml	>1000U/ml	MPR pulse	MPR pulse	108	104	Normal	Normal
11	M	R	21.7	26.4	26.4	2	>1000U/ml	>1000U/ml	MPR pulse	MPR pulse	101	92	HI+A HCL	HI+A HCL
12	M	L	32.7	32.9	32.9	1	>1000U/ml	>1000U/ml	PR oral	None	107	101	HI HCR	HI HCR
13	M	L	35.4	35.9	35.9	0	>1000U/ml	>1000U/ml	MPR pulse	None	103	84	HI AML+HCL	HI AML+HCL
14	F	R + L	55.3	60.9	61.9	1	>1000U/ml	>1000U/ml	MPR pulse	None	102	67	HI AMR+HCR, uWML	HI AMR+HCR, uWML
15	M	R	29.4	49.4	51.4	2	>1000U/ml	>1000U/ml	MPR pulse	MMF	71	104	HI AMR, uWML	uWML
16	F	L	24.4	24.8	26.8	2	>1000U/ml	>1000U/ml	MPR pulse	MMF	109	77	HI+VI AML+HCL	HI+VI AML+HCL
17	M	R	18.0	21.1	24.9	3	>1000U/ml	NA	MPR pulse	MPR pulse + BAS	80	67	Normal	Normal
18	F	L	42.0	47.4	47.9	2	>1000U/ml	>1000U/ml	MPR pulse	None	74	67	HI AML+HCL, uWML	HI AML+HCL, uWML
19	F	L	25.5	30.6	30.9	2	>1000U/ml	0U/ml	MPR pulse	MPR pulse	101	77	HI AML	HI AML

M: male, F: female, R: right, L: left, NA: not available, yrs: years, AEDs: antiepileptic drugs, Ab: serum antibody concentration, IT: immunotherapy, MPR:methylprednisolone, IVIG: intravenous immunoglobulin, PR: prednisolone, AZA: azathioprine, MMF: mycophenolate-mofetil, BAS: Basiliximab, uWML: unspecific white matter lesions, HI: hyperintensity, A: atrophy, VI: volume increase, AMR: right amygdala, AML: left amygdala, HCR: right hippocampus, HCL: left hippocampus.

Table S2. Clinical characteristics of LGI1-LE patients.

Patient	Gender	Laterali-zation	Age at onset, yrs	Age at 1st visit, yrs	Age at study, yrs	# of AEDs at study	Ab at 1st visit	Ab at study	Initial IT	IT at study	Verbal memory at study	Figural memory at study	Clinical MRI at 1st visit	Clinical MRI at study
1	M	R	67.8	67.8	69	2	VGKC > 100 pM LGI1 1:10 CASPR2 <1:10	VGKC NA LGI1 NA CASPR2 NA	MPR pulse	None	71	76	HI+VI AMR+AML	VI AMR A HCL+HCR
2	M	L	59.7	60.0	64.7	1	VGKC >7655pM LGI1 1:100 CASPR2 <1:10	VGKC NA LGI1 NA CASPR2 NA	MPR pulse	None	96	83	HI AMR+ AML+HCR	HI+A AMR+AML+ HCR+HCL
3	F	L	61.1	61.2	63.4	1	VGKC 679pM LGI1 1:100 CASPR2 <1:10	VGKC 0pM LGI1 <1:10 CASPR2 <1:10	MPR pulse	None	64	59	HI+VI HCR	HI+A HCR+HCL
4	F	R	57.0	57.1	57.2	2	VGKC 558pM LGI1 1:10 CASPR2 <1:10	VGKC 558pM LGI1 1:10 CASPR2 <1:10	PR oral	MPR pulse	86	73	Normal	Normal

M: male, F: female, R: right, L: left, NA: not available, yrs: years, AEDs: antiepileptic drugs, Ab: serum antibody concentration, IT: immunotherapy, MPR: methylprednisolone, IVIG: intravenous immunoglobulin, PR: prednisolone, AZA: azathioprine, MMF: mycophenolate-mofetil, IA: immunoadsorption, uWML: unspecific white matter lesions, HI: hyperintensity, A: atrophy, VI: volume increase, AMR: right amygdala, AML: left amygdala, HCR: right hippocampus, HCL: left hippocampus.

Table S3. Clinical characteristics of CASPR2-LE patients.

Patient	Gender	Laterali-zation	Age at onset, yrs	Age at 1st visit, yrs	Age at study, yrs	# of AEDs at study	Ab at 1st visit	Ab at study	Initial IT	IT at study	Verbal memory at study	Figural memory at study	Clinical MRI at 1st visit	Clinical MRI at study
1	M	L	69.7	70.2	75.6	1	VGKC 1419pM LGI1 <1:10 CASPR2 1:1000	VGKC NA LGI1 NA CASPR2 NA	MPR pulse	None	93	82	HI+VI AML	A HCR+HCL
2	M	L	38.0	38.5	40.4	2	VGKC 475pM LGI1 <1:10 CASPR2 1:1000	VGKC 1929pM LGI1 <1:10 CASPR2 1:1000	MPR pulse	PR oral+ MMF	92	107	HI AMR	Normal
3	M	R	68.1	69.1	72.6	1	VGKC 556pM LGI1 <1:10 CASPR2 1:100	VGKC 46pM LGI1 <1:10 CASPR2 <1:10	MPR pulse	None	81	96	Normal	A HCR+HCL
4	M	R + L	47.6	47.9	52.7	1	VGKC 1336pM LGI1 <1:10 CASPR2 1:3200	VGKC 502pM LGI1 <1:10 CASPR2 1:3200	MPR pulse	None	93	87	HI+VI AMR+AML, HI HCR+HCL	HI AMR+AML
5	M	L	48.4	51.0	51.0	2	VGKC 1203pM LGI1 <1:10 CASPR2 1:3200	VGKC 1203pM LGI1 <1:10 CASPR2 1:3200	MPR pulse	MPR pulse	90	84	Normal	Normal

M: male, F: female, R: right, L: left, NA: not available, yrs: years, AEDs: antiepileptic drugs, Ab: serum antibody concentration, IT: immunotherapy, MPR: methylprednisolone, IVIG: intravenous immunoglobulin, PR: prednisolone, AZA: azathioprine, MMF: mycophenolate-mofetil, IA: immunoadsorption, uWML: unspecific white matter lesions, HI: hyperintensity, A: atrophy, VI: volume increase, AMR: right amygdala, AML: left amygdala, HCR: right hippocampus, HCL: left hippocampus.

Table S4. Clinical characteristics of HS patients.

Patient	**Sex**	**Side of HS**	**Age at onset ,yrs**	**Age at study, yrs**	**# of AEDs at study**
1	M	R	6.0	26.0	3
2	F	L + R	22.0	27.5	1
3	F	L	23.0	39.3	2
4	F	R	0.5	18.9	1
5	M	R	11.2	19.1	2
6	F	R	21.0	36.4	2
7	M	L	12.0	32.9	2
8	M	L	9.4	44.3	2
9	M	L	8.0	27.2	1
10	F	L	15.0	24.5	2
11	F	L	14.0	54.6	2
12	F	L	17.0	28.2	3
13	M	L	6.0	39.5	3
14	F	L	23.0	29.5	2
15	F	R	11.7	24.6	2
16	F	L	32.0	40.0	2
17	F	R	12.0	59.1	3
18	M	R	21.0	50.5	2
19	M	L + R	34.3	46.1	1
20	M	L	30.8	46.8	2

M: male, F: female, R: right, L: left, yrs: years, AEDs: antiepileptic drugs, NA: not available

Table S5. Statistical values of all two-tailed t-tests using connectivity-based fixel enhancement conducted in this study.

Contrast	Metric	min *p*-value	max *t*-value	number of voxels containing fixels with fwe-corrected $p < 0.05$	location of fixels with fwe-corrected $p < 0.05$
GAD-LE < HC	FD	0.017 *	6.02	102	BL SLF
	ln(FC)	0.035*	5.38	58	Isthmus CC
	FDC	0.002 **	5.58	829	BL SLF, isthmus CC
GAD-LE > HC	FD	0.924	4.64	0	
	ln(FC)	0.616	4.22	0	
	FDC	0.652	5.04	0	
GAD-LE < HS	FD	0.101	6.78	0	
	ln(FC)	0.651	5.41	0	
	FDC	0.596	6.28	0	
GAD-LE > HS	FD	0.082	8.33	0	
	ln(FC)	0.012 *	6.99	92	Anterior commisure
	FDC	0.139	6.28	0	
LGI1-LE < HC	FD	0.14	7.08	0	
	ln(FC)	0.21	6.72	0	
	FDC	0.22	7.59	0	
LGI1-LE > HC	FD	0.96	7.11	0	
	ln(FC)	0.80	4.96	0	
	FDC	0.95	8.32	0	
LGI1-LE < HS	FD	0.65	7.31	0	
	ln(FC)	0.64	5.36	0	
	FDC	0.52	8.11	0	
LGI1-LE > HS	FD	0.11	7.30	0	
	ln(FC)	0.14	3.49	0	
	FDC	0.07	7.76	0	
CASPR2-LE < HC	FD	0.33	7.32	0	
	ln(FC)	0.09	5.87	0	
	FDC	0.07	6.54	0	

CASPR2-LE > HC	FD	0.64	7.78	0	
	ln(FC)	0.97	5.69	0	
	FDC	0.59	6.11	0	
CASPR2-LE < HS	FD	0.47	6.85	0	
	ln(FC)	0.91	3.02	0	
	FDC	0.70	6.47	0	
CASPR2-LE > HS	FD	0.11	8.08	0	
	ln(FC)	0.01 *	10.16	218	cerebellar peduncle + splenium of CC
	FDC	0.03 *	11.19	56	cerebellar peduncle
LGI1-LE < GAD-LE	FD	0.95	6.20	0	
	ln(FC)	0.55	3.67	0	
	FDC	0.93	6.06	0	
LGI1-LE > GAD-LE	FD	0.06	6.49	0	
	ln(FC)	0.37	3.14	0	
	FDC	0.34	5.78	0	
CASPR2-LE < GAD-LE	FD	0.92	5.27	0	
	ln(FC)	0.51	4.18	0	
	FDC	0.65	5.96	0	
CASPR2-LE > GAD-LE	FD	0.25	5.10	0	
	ln(FC)	0.42	3.65	0	
	FDC	0.12	4.61	0	
CASPR2-LE < LGI1-LE	FD	0.24	18.08	0	
	ln(FC)	0.79	10.63	0	
	FDC	0.83	13.67	0	
CASPR2-LE > LGI1-LE	FD	0.42	18.30	0	
	ln(FC)	0.12	15.09	0	
	FDC	0.22	14.58	0	

BL: bilateral, FD: fiber density, FC: fiber cross-section, FDC: fiber density and cross-section, SLF: superior longitudinal fascicle, CC: corpus callosum

Table S6. Analysis of variance and Tukey-Kramer post-hoc pairwise comparison of extracted superior longitudinal fascicle FDC fixel metrics across all groups adjusting for age.

ANCOVA	Post-hoc tests (Tukey-Kramer)	*t*-value	*p*-value
$F(9,152)=6.57$	HC <> GAD-LE aff.	4.25	< 0.001 ***
$p<0.001$	HC <> GAD-LE not aff.	3.34	0.029 *
$\eta^2=0.28$	HC <> LGI1-LE aff.	2.29	0.353
	HC <> LGI1-LE not aff.	0.89	0.993
	HC <> CASPR2-LE aff.	4.04	0.003 **
	HC <> CASPR2-LE aff.	2.06	0.506
	HC <> HS aff.	4.74	< 0.001 ***
	HC <> HS not aff.	0.96	0.989
	GAD-LE aff. <> GAD-LE not aff.	-0.74	0.998
	GAD-LE aff. <> LGI1-LE aff.	0.17	1.000
	GAD-LE aff. <> LGI1-LE not aff.	-2.77	0.132
	GAD-LE aff. <> CASPR2-LE aff.	1.52	0.847
	GAD-LE aff. <> CASPR2-LE not aff.	-0.28	1.000
	GAD-LE aff. <> HS aff.	0.33	1.000
	GAD-LE aff <> HS not aff.	-2.72	0.149
	GAD-LE not aff. <> LGI1-LE aff.	0.59	1.000
	GAD-LE not aff. <> LGI1-LE not aff.	-2.35	0.318
	GAD-LE not aff. <> CASPR2-LE aff.	1.98	0.560
	GAD-LE not aff. <> CASPR2-LE not aff.	0.18	1.000
	GAD-LE not aff. <> HS aff.	1.08	0.976
	GAD-LE not aff. <> HS not aff.	-1.97	0.566
	LGI1-LE aff. <> LGI1-LE not aff.	-2.39	0.297
	LGI1-LE aff <> CASPR2-LE aff.	1.03	0.982
	LGI1-LE aff <> CASPR2-LE not aff.	-0.36	1.000
	LGI1-LE aff. <> HS aff.	0.02	1.000
	LGI1-LE aff. <> HS not aff.	-1.69	0.753
	LGI1-LE not aff <> CASPR2-LE aff.	3.35	0.015 *
	LGI1-LE not aff <> CASPR2-LE not aff.	2.15	0.441
	LGI1-LE not aff. <> HS aff.	2.95	0.082
	LGI1-LE not aff <> HS not aff	1.26	0.941
	CASPR2-LE aff. <> CASPR2-LE not aff.	-1.48	0.864
	CASPR2-LE aff. <>HS aff.	-1.32	0.925
	CASPR2-LE aff. <> HS not aff.	-3.21	0.042 *
	CASPR2-LE not aff. <> HS aff.	0.49	1.000
	CASPR2-LE not aff. <> HS not aff.	-1.40	0.896
	HS aff. <> HS not aff.	-3.09	0.058

aff.: affected hemisphere, FDC: fiber density and cross-section

Table S7. Analysis of variance and Tukey-Kramer post-hoc pairwise comparison of extracted superior longitudinal fascicle FDC fixel metrics across all groups adjusting for age and seizure freedom.

ANCOVA	Post-hoc tests (Tukey-Kramer)	*t*-value	*p*-value
$F(9,86)=2.71$	GAD-LE aff. <> GAD-LE not aff.	-0.71	0.997
$P=0.008$	GAD-LE aff. <> LGI1-LE aff.	-0.39	1.000
$\eta^2=0.22$	GAD-LE aff. <> LGI1-LE not aff.	-3.02	0.063
	GAD-LE aff. <> CASPR2-LE aff.	1.08	0.960
	GAD-LE aff. <> CASPR2-LE not aff.	-0.58	0.999
	GAD-LE aff. <> HS aff.	0.50	1.000
	GAD-LE aff <> HS not aff.	-2.38	0.265
	GAD-LE not aff. <> LGI1-LE aff.	-0.01	1.000
	GAD-LE not aff. <> LGI1-LE not aff.	-2.64	0.155
	GAD-LE not aff. <> CASPR2-LE aff.	1.50	0.805
	GAD-LE not aff. <> CASPR2-LE not aff.	-0.15	1.000
	GAD-LE not aff. <> HS aff.	1.21	0.927
	GAD-LE not aff. <> HS not aff	-1.67	0.707
	LGI1-LE aff. <> LGI1-LE not aff.	-2.28	0.317
	LGI1-LE aff <> CASPR2-LE aff.	1.20	0.929
	LGI1-LE aff <> CASPR2-LE not aff.	-0.11	1.000
	LGI1-LE aff. <> HS aff.	0.64	0.998
	LGI1-LE aff. <> HS not aff.	-0.86	0.989
	LGI1-LE not aff <> CASPR2-LE aff.	3.58	0.013 *
	LGI1-LE not aff <> CASPR2-LE not aff.	2.26	0.325
	LGI1-LE not aff. <> HS aff.	3.24	0.035 *
	LGI1-LE not aff <> HS not aff.	1.74	0.663
	CASPR2-LE aff. <> CASPR2-LE not aff.	-1.41	0.851
	CASPR2-LE aff. <>HS aff.	-0.77	0.994
	CASPR2-LE aff. <> HS not aff.	-2.50	0.211
	CASPR2-LE not aff. <> HS aff.	0.87	0.988
	CASPR2-LE not aff. <> HS not aff.	-0.85	0.990
	HS aff. <> HS not aff.	-2.95	0.076

aff.: affected hemisphere, FDC: fiber density and cross-section

Table S8. Statistical values of all correlation analyses between ROI-wise fixel metrics and memory performance. P-values are reported uncorrected and after applying a Holm-Bonferroni procedure to correct p-values for multiple comparisons.

ROI	hemisphere	metric	Verbal memory			Figural Memory		
			Pearson *R*	*p*	H.-B.-corr. *p*	Pearson *R*	*p*	H.-B.-corr. *p*
SLF	Affected	FD	-0.047	0.847	1.000	-0.092	0.707	1.000
		FC	-0.128	0.601	1.000	0.169	0.489	1.000
		FDC	0.013	0.958	1.000	0.112	0.649	1.000
	Unaffected	FD	0.009	0.971	1.000	0.159	0.516	1.000
		FC	-0.084	0.731	1.000	-0.090	0.715	1.000
		FDC	0.038	0.878	1.000	0.108	0.660	1.000
	L	FD	-0.268	0.267	1.000	0.026	0.917	1.000
		FC	0.213	0.380	1.000	0.215	0.377	1.000
		FDC	0.088	0.719	1.000	0.170	0.487	1.000
	R	FD	0.162	0.505	1.000	0.073	0.765	1.000
		FC	-0.418	0.075	1.000	-0.106	0.665	1.000
		FDC	-0.028	0.908	1.000	0.057	0.817	1.000
	2(L-R)/(L+R)	FD	-0.348	0.144	1.000	-0.032	0.898	1.000
		FC	0.684	0.001	0.048 *	0.301	0.210	1.000
		FDC	0.197	0.419	1.000	0.188	0.441	1.000
	(L+R)/2	FD	-0.011	0.971	1.000	0.064	0.515	1.000
		FC	-0.126	0.601	1.000	0.058	0.810	1.000
		FDC	0.029	0.906	1.000	0.117	0.632	1.000
Hippo-campus	affected		-0.136	0.577	1.000	0.363	0.126	1.000
	unaffected		-0.008	0.972	1.000	0.430	0.066	1.000
	L		-0.135	0.580	1.000	-0.228	0.347	1.000
	R		-0.116	0.638	1.000	0.018	0.943	1.000
	2(L-R)/(L+R)		<0.001	1.000	1.000	-0.212	0.383	1.000
	(L+R)/2		-0.150	0.539	1.000	-0.124	0.611	1.000

SLF: superior longitudinal fascicle, R: right, L: left, H.-B.-corr.: Holm-Bonferroni correceted values.

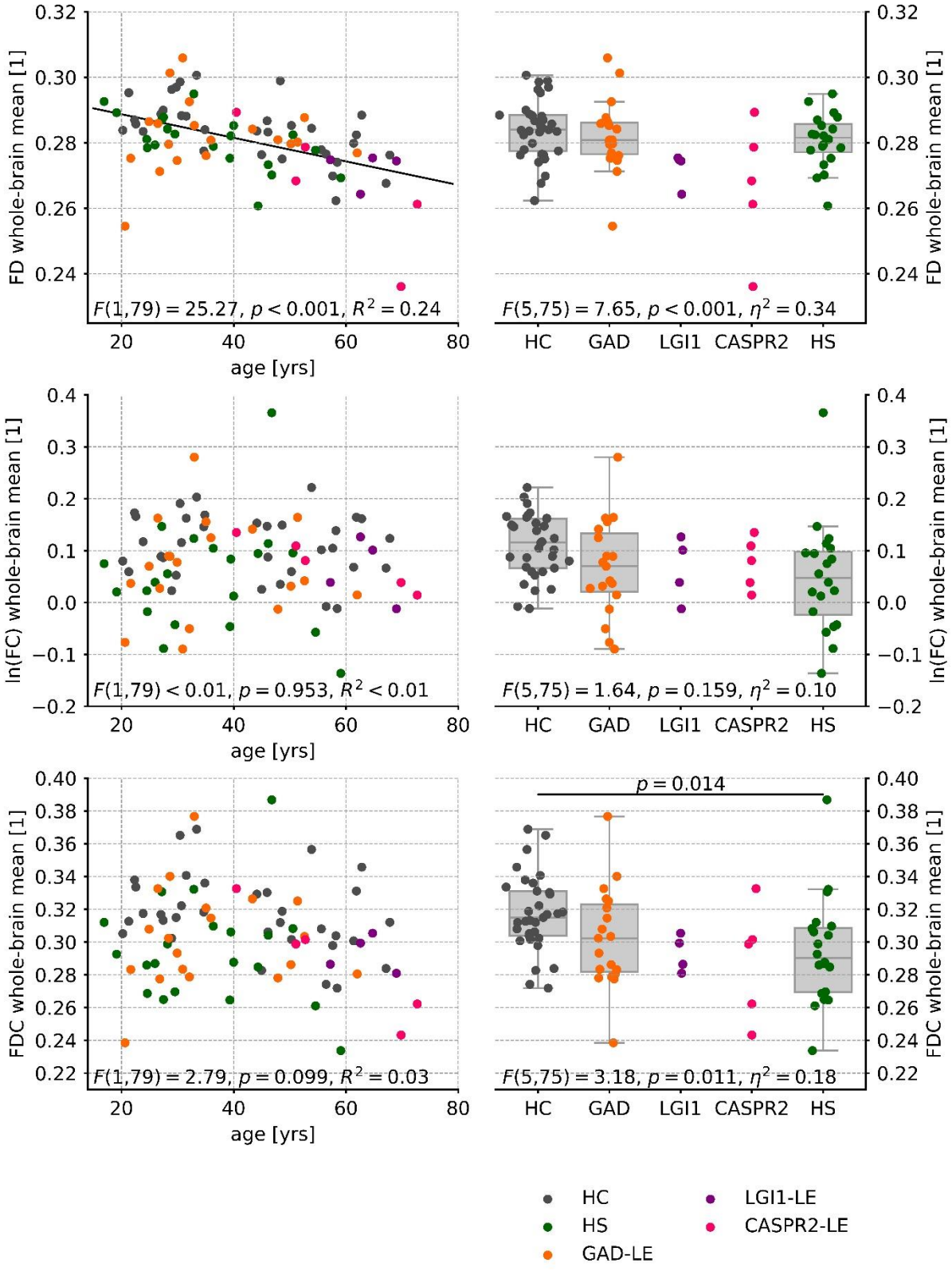

Figure S1. Whole-brain average ln(FC), FD and FDC values of all subjects over age including results of regression analysis (left) and grouped with results of ANCOVAs adjusting for age (right).

FD: fiber density, FC: fiber cross-section, FDC: fiber density and cross-section, yrs: years

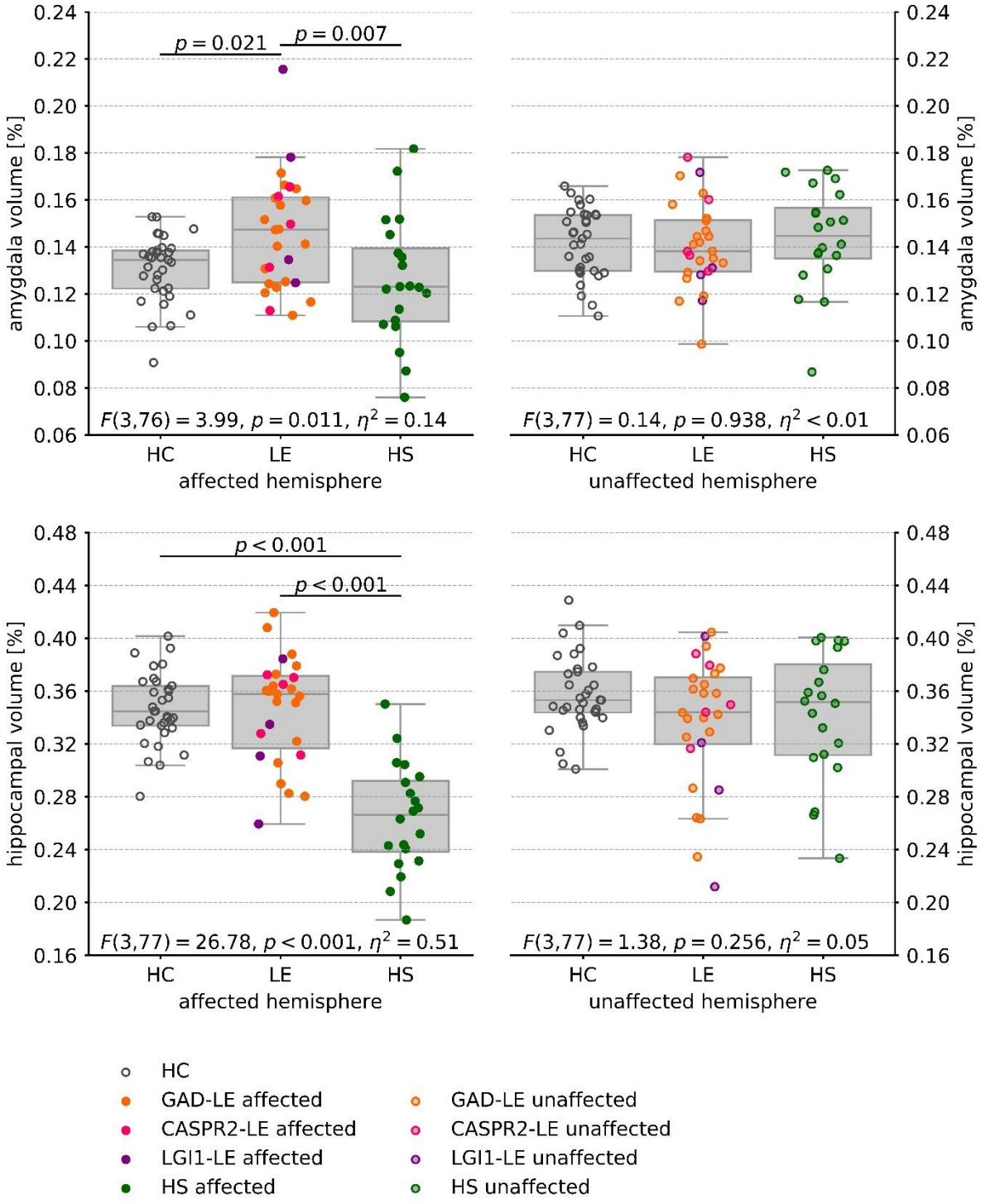

Figure S2. Whole-brain corrected amygdala (top) and hippocampal (bottom) volumes on the affected (left) and unaffected (right) hemisphere including results of ANCOVAs adjusting for age.