Supplementary Materials

Estimating k_{max} for Higuchi's fractal dimension

Wanliss & Wanliss performed a series of simulations using fractional Brownian motion [37]. For each, they calculated Higuchi fractal dimension (HFD) across a range of k_{max} values and compared the computed HFD to the expected theoretical fractal dimension of the signal. They then took the geometric mean of these curves and used a sum of sines equation to estimate the best fit line. This produced the following formula for estimating the optimal k_{max} for N samples:

$$k_{max} = [A_1 \sin(B_1 * N + C_1) + A_2 \sin(B_2 * N + C_2)] \quad (4)$$

Here, [ ] means only the integer component of the k_{max} is used. Estimates for the best fitting equation are given in Supplemental Table 1.

Table S1. Estimates of best fitting parameters for k_{max} function

Parameter	Estimate
A_1	129.8 ± 3.0
B_1	(1.292 ± 0.045) x 10^{-5}
C_1	0.04488 ± 0.0255
A_2	18.82 ± 2.56
B_2	(6.488 ± 0.280) x 10^{-5}
C_2	1.332 ± 0.220

We assumed a Gaussian distribution of parameters, then sampled from these distributions and generated 10,000 k_{max} values and selected the modal response. This approach resulted in k_{max} = 108 for calculating HFD with the full time-course, and k_{max} = 25 for calculating HFD for the windowed data.

Figure S1. Channel correlations for full time-course fractal dimension. Heatmap showing channel-by-channel correlations for HFD (upper right triangle) and KFD (lower left triangle). Note that all resulting correlations are positive.

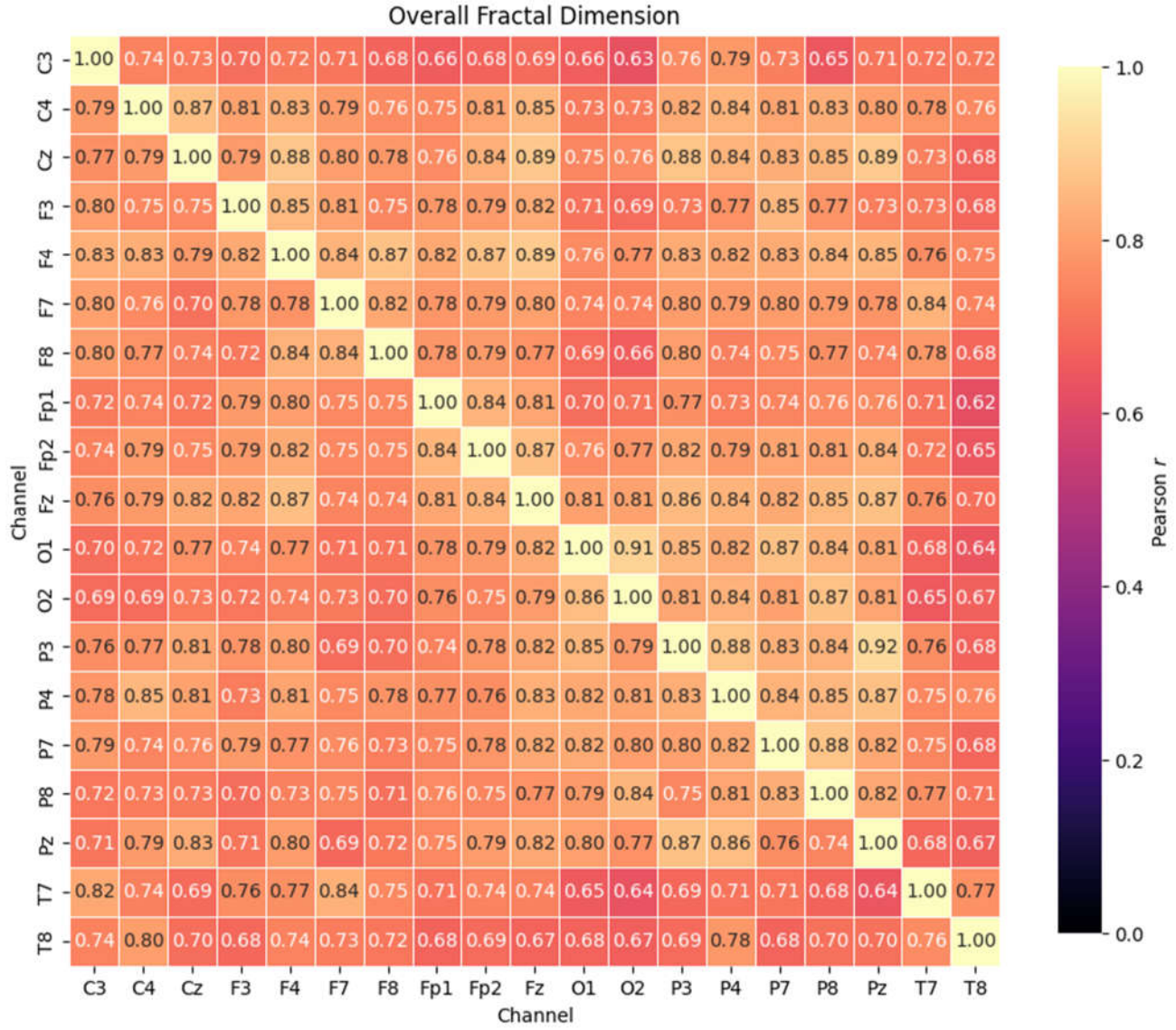


Figure S2. Channel correlations for windowed fractal mean. Heatmap showing channel-by-channel correlations for HFD (upper right triangle) and KFD (lower left triangle). Note that all resulting correlations are positive.

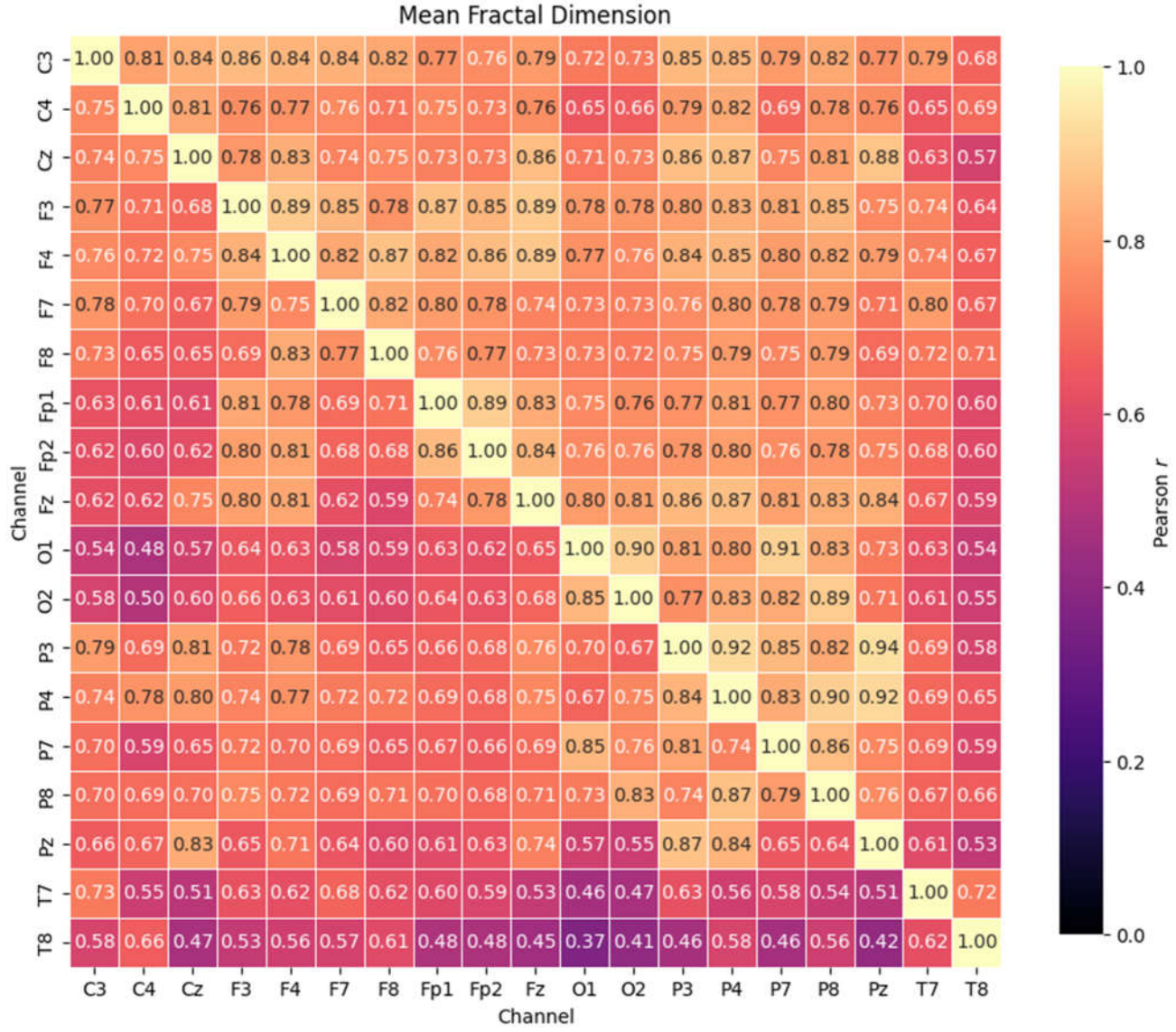


Figure S3. Channel correlations for windowed fractal standard deviation. Heatmap showing channel-by-channel correlations for HFD (upper right triangle) and KFD (lower left triangle). Note that all resulting correlations are positive.

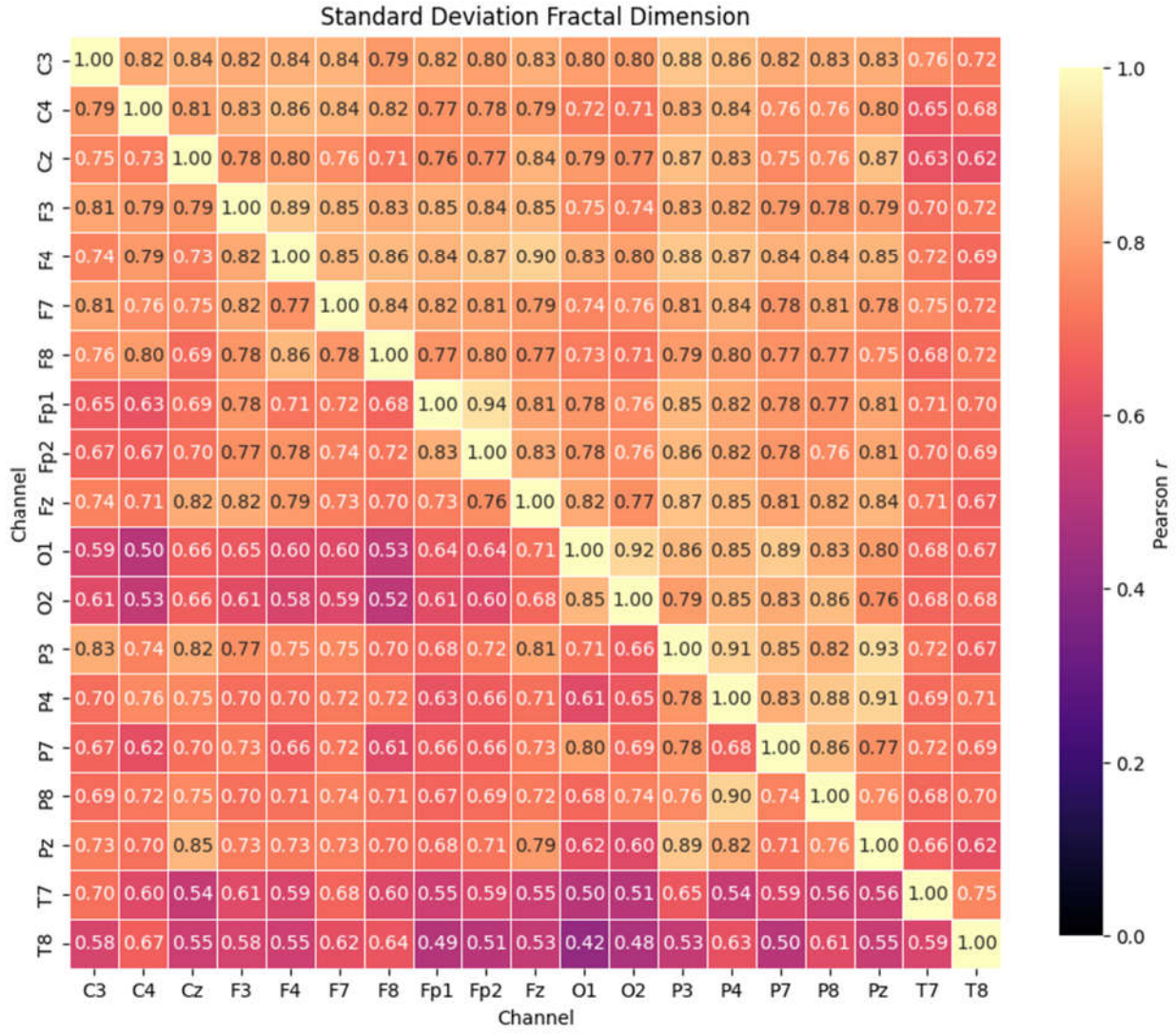


Table S2. Summary of models predicting Dementia vs SCI using Higuchi fractal information with different window lengths

Band	Model	Window	AIC	Pseudo R^2	L1 penalty	n_{params}	X^2	p
Broadband	Full time-course		180.3	0.290	1.60	11	24.74	0.0033
	FDD features	0.5 s	171.6	0.310	3.75	5	21.41	0.0001
	FDD features	1 s	163.6	0.446	1.85	6	47.40	0.0111
	FDD features	5 s	171.7	0.339	4.10	6	23.31	0.0001
	FDD features	10 s	173.0	0.339	3.40	7	24.07	0.0002
Delta	Full time-course		178.8	0.425	0.25	19	42.20	0.0006
	FDD features	0.5 s	182.3	0.252	0.65	11	22.70	0.0069
	FDD features	1 s	176.1	0.397	1.90	19	44.91	0.0003
	FDD features	5 s	178.7	0.371	3.00	10	24.32	0.0020
	FDD features	10 s	180.9	0.409	1.75	13	28.17	0.0030
Theta	Full time-course		174.9	0.269	1.70	6	20.13	0.0005
	FDD features	0.5 s	164.1	0.582	0.10	34	86.91	0.0000
	FDD features	1 s	159.6	0.592	0.85	23	69.44	0.0000
	FDD features	5 s	165.4	0.494	2.25	9	35.61	0.0000
	FDD features	10 s	176.3	0.259	3.25	6	18.79	0.0009
Alpha	Full time-course		182.0	0.262	1.85	6	13.04	0.0111
	FDD features	0.5 s	171.0	0.467	0.65	20	52.08	0.0000
	FDD features	1 s	166.6	0.644	0.75	25	66.42	0.0000
	FDD features	5 s	170.0	0.476	0.90	23	59.06	0.0000
	FDD features	10 s	173.8	0.507	0.95	21	51.25	0.0001
Beta	Full time-course		179.5	0.240	2.15	7	17.57	0.0035
	FDD features	0.5 s	171.0	0.349	1.05	12	36.06	0.0001
	FDD features	1 s	173.0	0.377	1.90	14	38.05	0.0002
	FDD features	5 s	169.2	0.407	1.00	20	53.84	0.0000
	FDD features	10 s	175.4	0.565	0.45	28	63.63	0.0001
Gamma	Full time-course		184.4	0.298	0.60	14	26.65	0.0087
	FDD features	0.5 s	176.3	0.389	0.25	16	38.77	0.0004
	FDD features	1 s	184.7	0.220	4.75	5	8.33	0.0396
	FDD features	5 s	182.3	0.279	1.60	12	24.77	0.0058
	FDD features	10 s	187.2	0.096	4.10	3	1.85	0.1742

The number of non-zero parameters in the model (n_{params}) including the intercept.

Table S3. Summary of models predicting Dementia vs SCI using Katz fractal information with different window lengths

Band	Model	Window	AIC	Pseudo R^2	L1 penalty	n_{params}	X^2	p
Broadband	Full time-course		189.2	0.058	5.65	2	-2.17	1.0000
	FDD features	0.5 s	175.6	0.269	4.65	6	19.48	0.0006
	FDD features	1 s	176.5	0.299	0.25	19	16.54	0.0006
	FDD features	5 s	182.0	0.152	4.90	5	11.05	0.0115
	FDD features	10 s	185.4	0.153	4.15	6	9.64	0.0470
Delta	Full time-course		190.8	0.087	3.70	4	0.28	0.8698
	FDD features	0.5 s	184.0	0.476	1.25	24	47.09	0.0014
	FDD features	1 s	183.0	0.261	3.55	11	22.09	0.0086
	FDD features	5 s	187.3	0.486	0.70	28	51.76	0.0019
	FDD features	10 s	189.6	0.202	4.75	6	5.45	0.2440
Theta	Full time-course		179.6	0.398	0.60	16	35.46	0.0013
	FDD features	0.5 s	165.0	0.592	0.45	28	74.03	0.0000
	FDD features	1 s	174.8	0.358	2.40	8	24.20	0.0005
	FDD features	5 s	167.8	0.653	0.85	26	67.27	0.0000
	FDD features	10 s	175.6	0.603	0.80	27	61.45	0.0001
Alpha	Full time-course		187.0	0.223	3.50	5	6.03	0.1100
	FDD features	0.5 s	185.0	0.211	5.40	5	8.04	0.0451
	FDD features	1 s	186.1	0.229	5.05	6	8.96	0.0622
	FDD features	5 s	190.2	0.125	4.50	5	2.85	0.4160
	FDD features	10 s	190.6	0.058	5.10	3	-1.52	1.0000
Beta	Full time-course		188.1	0.133	2.45	7	8.93	0.1120
	FDD features	0.5 s	186.6	0.280	3.05	11	18.40	0.0308
	FDD features	1 s	178.9	0.270	4.25	7	18.12	0.0028
	FDD features	5 s	177.0	0.429	2.65	12	30.05	0.0008
	FDD features	10 s	182.0	0.302	2.80	11	23.00	0.0062
Gamma	Full time-course		189.1	0.135	2.85	4	1.99	0.3705
	FDD features	0.5 s	186.9	0.329	2.40	12	20.17	0.0277
	FDD features	1 s	194.1	0.232	4.70	9	6.98	0.4313
	FDD features	5 s	185.9	0.145	4.65	4	5.13	0.0768
	FDD features	10 s	189.0	0.036	4.35	4	2.04	0.3605

The number of non-zero parameters in the model (n_{params}) including the intercept.

Table S4. Summary of models predicting AD vs SCI using Katz fractal information with different window lengths

Band	Model	Window	AIC	Pseudo R^2	L1 penalty	n_{params}	X^2	p
Broadband	Full time-course		157.0	0.204	1.45	10	24.40	0.0020
	FDD features	0.5 s	151.1	0.341	0.60	25	60.24	0.0000
	FDD features	1 s	151.6	0.331	0.85	22	53.77	0.0001
	FDD features	5 s	152.5	0.380	0.55	27	62.88	0.0000
	FDD features	10 s	150.2	0.292	0.90	21	53.23	0.0000
Delta	Full time-course		153.8	0.291	0.05	20	47.60	0.0002
	FDD features	0.5 s	155.1	0.253	0.25	18	42.30	0.0004
	FDD features	1 s	144.0	0.342	1.80	17	51.40	0.0000
	FDD features	5 s	156.4	0.254	2.60	12	28.98	0.0013
	FDD features	10 s	159.9	0.117	3.00	9	19.47	0.0068
Theta	Full time-course		145.6	0.400	0.40	16	47.83	0.0000
	FDD features	0.5 s	155.6	0.185	1.60	9	23.82	0.0012
	FDD features	1 s	147.5	0.487	0.15	33	79.86	0.0000
	FDD features	5 s	154.6	0.205	2.50	9	24.84	0.0008
	FDD features	10 s	159.8	0.068	3.45	6	13.57	0.0088
Alpha	Full time-course		165.3	0.058	1.35	8	12.13	0.0592
	FDD features	0.5 s	160.4	0.156	1.15	11	22.94	0.0063
	FDD features	1 s	159.8	0.360	0.40	29	59.55	0.0003
	FDD features	5 s	165.7	0.039	4.15	5	5.69	0.1279
	FDD features	10 s	158.6	0.439	0.25	31	64.77	0.0002
Beta	Full time-course		149.7	0.300	0.35	18	47.70	0.0001
	FDD features	0.5 s	160.5	0.459	0.15	34	68.92	0.0002
	FDD features	1 s	152.9	0.214	1.80	14	36.54	0.0003
	FDD features	5 s	149.7	0.547	0.10	37	85.73	0.0000
	FDD features	10 s	166.0	0.059	3.85	6	7.42	0.1155
Gamma	Full time-course		156.7	0.067	1.30	8	20.74	0.0020
	FDD features	0.5 s	157.0	0.107	0.55	10	24.39	0.0020
	FDD features	1 s	165.6	0.117	2.25	11	17.84	0.0371
	FDD features	5 s	164.7	0.175	1.55	14	24.73	0.0161
	FDD features	10 s	166.7	0.020	3.60	6	6.68	0.1537

The number of non-zero parameters in the model (n_{params}) including the intercept.

Table S5. Summary of models predicting AD vs SCI using Katz fractal information with different window lengths

Band	Model	Window	AIC	Pseudo R^2	L1 penalty	n_{params}	X^2	p
Broadband	Full time-course		159.6	0.088	2.90	4	9.77	0.0076
	FDD features	0.5 s	155.1	0.301	1.10	22	50.29	0.0002
	FDD features	1 s	148.9	0.507	0.30	32	76.48	0.0000
	FDD features	5 s	156.2	0.213	1.10	18	41.15	0.0005
	FDD features	10 s	158.1	0.322	0.75	22	47.24	0.0005
Delta	Full time-course		167.6	0.009	2.45	5	3.83	0.2804
	FDD features	0.5 s	150.6	0.262	1.95	14	38.82	0.0001
	FDD features	1 s	155.5	0.224	2.15	15	35.90	0.0006
	FDD features	5 s	167.9	0.117	2.80	14	21.49	0.0436
	FDD features	10 s	162.3	0.283	1.6	20	39.14	0.0027
Theta	Full time-course		156.8	0.341	0.15	19	42.64	0.0005
	FDD features	0.5 s	154.4	0.234	1.50	14	35.00	0.0005
	FDD features	1 s	154.8	0.126	2.25	8	22.64	0.0009
	FDD features	5 s	150.9	0.215	2.40	10	30.49	0.0002
	FDD features	10 s	151.5	0.263	1.85	12	33.88	0.0002
Alpha	Full time-course		162.7	0.165	1.25	13	24.68	0.0101
	FDD features	0.5 s	162.6	0.020	5.25	3	4.78	0.0289
	FDD features	1 s	164.9	0.107	2.75	8	12.49	0.0519
	FDD features	5 s	171.0	0.020	2.65	10	10.35	0.2410
	FDD features	10 s	166.2	0.000	3.40	5	5.18	0.1589
Beta	Full time-course		159.1	0.252	0.65	15	32.26	0.0022
	FDD features	0.5 s	161.9	0.429	0.15	33	65.54	0.0003
	FDD features	1 s	163.6	0.049	4.45	5	7.83	0.0496
	FDD features	5 s	148.8	0.330	0.85	26	64.59	0.0000
	FDD features	10 s	145.8	0.272	2.05	14	43.59	0.0000
Gamma	Full time-course		168.5	0.000	3.80	4	0.93	0.6266
	FDD features	0.5 s	164.1	0.147	2.80	11	19.29	0.0228
	FDD features	1 s	161.7	0.233	1.20	21	41.69	0.0020
	FDD features	5 s	165.9	0.058	2.85	13	21.51	0.0285
	FDD features	10 s	168.2	0.029	3.80	8	9.20	0.1628

The number of non-zero parameters in the model (n_{params}) including the intercept.