

**Table S1.** Entropy ~ State+(1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	-0.0015	-0.0038	0.0007	0.1818	0.0411	0.0100	0.0073	0.0137	0.0114	0.0106	0.0122
2	State	0.0011	-0.0012	0.0033	0.3527	0.0415	0.0094	0.0068	0.0129	0.0112	0.0105	0.0121
3	State	-0.0003	-0.0023	0.0016	0.7244	0.0265	0.0106	0.0078	0.0144	0.0098	0.0091	0.0105
4	State	-0.0020	-0.0041	0.0002	0.0686	0.0341	0.0069	0.0049	0.0097	0.0108	0.0100	0.0116
5	State	0.0015	-0.0008	0.0038	0.2039	0.0431	0.0085	0.0061	0.0117	0.0116	0.0108	0.0125
6	State	0.0048	0.0024	0.0071	0.0001	0.0367	0.0096	0.0070	0.0133	0.0117	0.0109	0.0126
7	State	-0.0012	-0.0033	0.0009	0.2646	0.0357	0.0082	0.0059	0.0113	0.0107	0.0100	0.0115
8	State	0.0005	-0.0014	0.0024	0.5917	0.0283	0.0067	0.0048	0.0093	0.0097	0.0090	0.0104
9	State	0.0005	-0.0016	0.0025	0.6520	0.0330	0.0080	0.0058	0.0111	0.0102	0.0095	0.0110
10	State	0.0007	-0.0015	0.0029	0.5365	0.0372	0.0101	0.0073	0.0138	0.0111	0.0103	0.0119
11	State	-0.0001	-0.0019	0.0018	0.9564	0.0302	0.0059	0.0042	0.0082	0.0095	0.0088	0.0102
12	State	-0.0003	-0.0022	0.0016	0.7742	0.0296	0.0063	0.0045	0.0087	0.0096	0.0090	0.0104
13	State	0.0012	-0.0010	0.0034	0.2813	0.0361	0.0075	0.0054	0.0104	0.0110	0.0103	0.0119
14	State	0.0004	-0.0017	0.0026	0.6956	0.0405	0.0102	0.0075	0.0140	0.0110	0.0102	0.0118
15	State	-0.0004	-0.0024	0.0017	0.7258	0.0327	0.0073	0.0053	0.0102	0.0104	0.0097	0.0112
16	State	0.0001	-0.0019	0.0021	0.9317	0.0367	0.0091	0.0066	0.0125	0.0103	0.0095	0.0110
17	State	0.0001	-0.0022	0.0024	0.9314	0.0460	0.0111	0.0081	0.0152	0.0116	0.0108	0.0125

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Red shade means that identified significance exists in all wavelength data.

**Table S2.** Entropy ~ State+(1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	-0.0014	-0.0036	0.0008	0.2217	0.0406	0.0084	0.0060	0.0116	0.0112	0.0104	0.0121
2	State	0.0018	-0.0005	0.0040	0.1234	0.0407	0.0085	0.0061	0.0117	0.0113	0.0105	0.0121
3	State	0.0004	-0.0015	0.0023	0.6678	0.0256	0.0096	0.0070	0.0131	0.0097	0.0090	0.0104
4	State	-0.0017	-0.0037	0.0002	0.0751	0.0322	0.0055	0.0039	0.0078	0.0098	0.0091	0.0105
5	State	-0.0002	-0.0025	0.0020	0.8462	0.0445	0.0087	0.0063	0.0120	0.0113	0.0105	0.0122
6	State	0.0029	0.0006	0.0052	0.0144	0.0357	0.0079	0.0057	0.0110	0.0116	0.0108	0.0124
7	State	-0.0017	-0.0036	0.0003	0.0900	0.0363	0.0078	0.0056	0.0107	0.0098	0.0091	0.0105
8	State	0.0000	-0.0018	0.0017	0.9791	0.0284	0.0052	0.0037	0.0074	0.0089	0.0083	0.0096
9	State	0.0013	-0.0008	0.0034	0.2222	0.0339	0.0073	0.0052	0.0101	0.0107	0.0100	0.0115
10	State	0.0030	0.0008	0.0052	0.0086	0.0376	0.0090	0.0065	0.0124	0.0113	0.0105	0.0121
11	State	-0.0002	-0.0021	0.0017	0.8412	0.0290	0.0049	0.0034	0.0070	0.0095	0.0088	0.0102
12	State	0.0009	-0.0011	0.0029	0.3889	0.0290	0.0061	0.0043	0.0086	0.0102	0.0095	0.0110
13	State	0.0005	-0.0015	0.0025	0.6177	0.0349	0.0063	0.0045	0.0089	0.0102	0.0095	0.0109
14	State	0.0000	-0.0021	0.0021	0.9937	0.0414	0.0096	0.0070	0.0131	0.0107	0.0100	0.0115
15	State	-0.0003	-0.0022	0.0017	0.7652	0.0308	0.0056	0.0039	0.0079	0.0099	0.0092	0.0106
16	State	0.0007	-0.0013	0.0028	0.4914	0.0361	0.0091	0.0066	0.0125	0.0103	0.0096	0.0111
17	State	0.0000	-0.0021	0.0022	0.9804	0.0443	0.0107	0.0078	0.0147	0.0110	0.0102	0.0118

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Red shade means that identified significance exists in all wavelength data.

**Table S3.** Entropy ~ State+(1|subject) , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	-0.0009	-0.0030	0.0012	0.3927	0.0351	0.0073	0.0053	0.0102	0.0105	0.0097	0.0112
2	State	0.0020	-0.0001	0.0040	0.0576	0.0341	0.0080	0.0058	0.0110	0.0103	0.0096	0.0110
3	State	-0.0001	-0.0018	0.0015	0.8942	0.0227	0.0075	0.0055	0.0103	0.0083	0.0077	0.0089
4	State	-0.0016	-0.0035	0.0002	0.0739	0.0290	0.0043	0.0030	0.0062	0.0092	0.0085	0.0098
5	State	0.0020	-0.0001	0.0042	0.0651	0.0389	0.0073	0.0052	0.0102	0.0110	0.0102	0.0118
6	State	0.0024	0.0004	0.0045	0.0213	0.0307	0.0065	0.0047	0.0091	0.0104	0.0097	0.0112
7	State	-0.0010	-0.0028	0.0008	0.2631	0.0299	0.0058	0.0041	0.0081	0.0090	0.0084	0.0096
8	State	-0.0002	-0.0018	0.0014	0.8484	0.0261	0.0045	0.0032	0.0064	0.0081	0.0075	0.0087
9	State	0.0000	-0.0017	0.0018	0.9913	0.0294	0.0053	0.0038	0.0075	0.0089	0.0083	0.0096
10	State	0.0002	-0.0018	0.0022	0.8658	0.0314	0.0076	0.0055	0.0105	0.0102	0.0095	0.0110
11	State	-0.0009	-0.0027	0.0008	0.3036	0.0276	0.0050	0.0036	0.0071	0.0090	0.0084	0.0097
12	State	0.0001	-0.0016	0.0018	0.9243	0.0267	0.0045	0.0032	0.0065	0.0086	0.0080	0.0092

13	State	0.0002	-0.0015	0.0020	0.7995	0.0303	0.0054	0.0038	0.0076	0.0088	0.0082	0.0095
14	State	-0.0012	-0.0032	0.0008	0.2547	0.0349	0.0076	0.0055	0.0105	0.0102	0.0095	0.0110
15	State	-0.0008	-0.0027	0.0010	0.3723	0.0278	0.0041	0.0028	0.0060	0.0093	0.0087	0.0100
16	State	-0.0002	-0.0020	0.0017	0.8622	0.0325	0.0077	0.0056	0.0106	0.0095	0.0088	0.0102
17	State	-0.0002	-0.0023	0.0018	0.8126	0.0402	0.0102	0.0074	0.0139	0.0104	0.0097	0.0112

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Red shade means that identified significance exists in all wavelength density data.

**Table S4.** Entropy ~ Rest duration+ (1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	0.0588	-0.2317	0.3492	0.6904	0.0405	0.0103	0.0074	0.0143	0.0107	0.0096	0.0119
2	RD	0.1366	-0.1465	0.4197	0.3426	0.0403	0.0108	0.0078	0.0149	0.0104	0.0094	0.0116
3	RD	-0.2010	-0.4611	0.0591	0.1291	0.0283	0.0115	0.0083	0.0158	0.0096	0.0086	0.0106
4	RD	0.0167	-0.2835	0.3168	0.9129	0.0339	0.0062	0.0041	0.0092	0.0111	0.0100	0.0123
5	RD	-0.0977	-0.4069	0.2115	0.5339	0.0440	0.0078	0.0054	0.0112	0.0114	0.0103	0.0126
6	RD	0.0143	-0.2703	0.2988	0.9213	0.0366	0.0094	0.0067	0.0132	0.0105	0.0094	0.0116
7	RD	0.0369	-0.2427	0.3165	0.7951	0.0354	0.0092	0.0066	0.0129	0.0103	0.0093	0.0114
8	RD	-0.0568	-0.3116	0.1980	0.6609	0.0288	0.0066	0.0046	0.0095	0.0094	0.0085	0.0104
9	RD	-0.0920	-0.3665	0.1825	0.5094	0.0338	0.0076	0.0054	0.0109	0.0101	0.0091	0.0112
10	RD	-0.0034	-0.2646	0.2578	0.9795	0.0372	0.0118	0.0086	0.0163	0.0096	0.0087	0.0107
11	RD	-0.1842	-0.4562	0.0877	0.1831	0.0319	0.0052	0.0034	0.0079	0.0100	0.0090	0.0111
12	RD	-0.0899	-0.3556	0.1758	0.5054	0.0304	0.0063	0.0043	0.0092	0.0098	0.0088	0.0109
13	RD	-0.0598	-0.3480	0.2284	0.6828	0.0366	0.0071	0.0049	0.0103	0.0106	0.0096	0.0118
14	RD	-0.1215	-0.4065	0.1636	0.4017	0.0416	0.0108	0.0078	0.0150	0.0105	0.0095	0.0117
15	RD	-0.2471	-0.5459	0.0517	0.1046	0.0349	0.0074	0.0051	0.0107	0.0110	0.0099	0.0122
16	RD	-0.1576	-0.4015	0.0863	0.2039	0.0381	0.0102	0.0074	0.0141	0.0090	0.0081	0.0100
17	RD	0.1103	-0.2001	0.4206	0.4844	0.0450	0.0117	0.0085	0.0163	0.0114	0.0103	0.0127

RD: rest duration, \* :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Entropy calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05

**Table S5.** Entropy ~ Rest duration+ (1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	0.2614	-0.0347	0.5576	0.0833	0.0383	0.0090	0.0063	0.0126	0.0109	0.0098	0.0121
2	RD	-0.1260	-0.4414	0.1894	0.4318	0.0418	0.0087	0.0061	0.0124	0.0116	0.0105	0.0129
3	RD	-0.1233	-0.3739	0.1272	0.3329	0.0267	0.0102	0.0074	0.0141	0.0092	0.0083	0.0102
4	RD	0.2004	-0.0629	0.4636	0.1350	0.0304	0.0052	0.0035	0.0079	0.0097	0.0087	0.0108
5	RD	0.0296	-0.2939	0.3530	0.8571	0.0442	0.0082	0.0057	0.0118	0.0119	0.0107	0.0132
6	RD	-0.1395	-0.4426	0.1637	0.3654	0.0369	0.0087	0.0061	0.0123	0.0112	0.0101	0.0124
7	RD	0.1827	-0.0686	0.4341	0.1533	0.0347	0.0096	0.0069	0.0133	0.0093	0.0083	0.0103
8	RD	0.1093	-0.1333	0.3519	0.3754	0.0274	0.0052	0.0035	0.0077	0.0089	0.0081	0.0099
9	RD	0.2223	-0.0454	0.4901	0.1031	0.0319	0.0083	0.0059	0.0117	0.0099	0.0089	0.0110
10	RD	-0.0212	-0.2807	0.2383	0.8722	0.0378	0.0104	0.0075	0.0144	0.0096	0.0086	0.0106
11	RD	-0.0674	-0.3308	0.1960	0.6144	0.0296	0.0049	0.0032	0.0075	0.0097	0.0087	0.0108
12	RD	0.1229	-0.1652	0.4111	0.4011	0.0279	0.0055	0.0036	0.0084	0.0106	0.0096	0.0118
13	RD	0.0788	-0.1862	0.3438	0.5582	0.0342	0.0062	0.0042	0.0090	0.0098	0.0088	0.0108
14	RD	0.0389	-0.2357	0.3135	0.7801	0.0411	0.0104	0.0075	0.0144	0.0101	0.0091	0.0112
15	RD	-0.0122	-0.2811	0.2567	0.9289	0.0309	0.0054	0.0036	0.0081	0.0099	0.0089	0.0110
16	RD	-0.0246	-0.2965	0.2474	0.8587	0.0364	0.0092	0.0066	0.0129	0.0100	0.0090	0.0111
17	RD	-0.0088	-0.3005	0.2829	0.9524	0.0444	0.0116	0.0084	0.0160	0.0107	0.0097	0.0119

RD: rest duration, \* :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Entropy calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05

**Table S6.** Entropy ~ Rest duration+ (1|subject) , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	0.1549	-0.1239	0.4338	0.2746	0.0337	0.0078	0.0055	0.0111	0.0103	0.0093	0.0114
2	RD	-0.0148	-0.2666	0.2369	0.9077	0.0342	0.0084	0.0060	0.0117	0.0093	0.0084	0.0103
3	RD	-0.0957	-0.3100	0.1185	0.3791	0.0235	0.0087	0.0063	0.0121	0.0079	0.0071	0.0088
4	RD	0.2276	-0.0125	0.4677	0.0630	0.0270	0.0044	0.0029	0.0068	0.0088	0.0080	0.0098
5	RD	0.0695	-0.2322	0.3712	0.6502	0.0383	0.0067	0.0045	0.0098	0.0111	0.0100	0.0123
6	RD	-0.1509	-0.4286	0.1268	0.2853	0.0320	0.0067	0.0046	0.0097	0.0102	0.0092	0.0114
7	RD	0.2664	0.0360	0.4969	0.0237	0.0275	0.0064	0.0045	0.0091	0.0085	0.0076	0.0094
8	RD	0.1810	-0.0395	0.4013	0.1070	0.0245	0.0048	0.0033	0.0071	0.0081	0.0073	0.0090
9	RD	0.0639	-0.1715	0.2992	0.5931	0.0288	0.0057	0.0039	0.0083	0.0087	0.0078	0.0096
10	RD	0.0527	-0.1968	0.3021	0.6776	0.0309	0.0095	0.0069	0.0132	0.0092	0.0083	0.0102
11	RD	-0.0484	-0.3056	0.2088	0.7111	0.0281	0.0056	0.0037	0.0082	0.0095	0.0085	0.0105
12	RD	0.0023	-0.2294	0.2340	0.9844	0.0267	0.0045	0.0030	0.0068	0.0085	0.0077	0.0095
13	RD	-0.0001	-0.2256	0.2254	0.9993	0.0303	0.0059	0.0041	0.0085	0.0083	0.0075	0.0092
14	RD	0.0215	-0.2480	0.2910	0.8751	0.0348	0.0085	0.0060	0.0119	0.0099	0.0089	0.0110
15	RD	-0.0483	-0.3019	0.2054	0.7079	0.0282	0.0051	0.0034	0.0076	0.0093	0.0084	0.0104
16	RD	0.0358	-0.1960	0.2675	0.7611	0.0321	0.0081	0.0058	0.0112	0.0085	0.0077	0.0095
17	RD	0.1890	-0.0843	0.4623	0.1743	0.0385	0.0102	0.0074	0.0142	0.0101	0.0091	0.0112

RD: rest duration, \*:  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Entropy calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength density data.

**Table S7.** Entropy ~ Task duration+ $\omega_n + \zeta$ +(1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	NF	-1.1429	-2.1869	-0.0990	0.0321	0.0378	0.0093	0.0066	0.0132	0.0120	0.0108	0.0133
	DR	0.8810	-3.2294	4.9913	0.6730							
	TD	0.4318	0.1012	0.7625	0.0107							
2	NF	0.4231	-0.5794	1.4257	0.4062	0.0407	0.0083	0.0058	0.0119	0.0115	0.0103	0.0127
	DR	-2.0181	-5.9655	1.9292	0.3146							
	TD	0.2635	-0.0541	0.5810	0.1034							
3	NF	-0.8985	-1.7501	-0.0469	0.0388	0.0290	0.0097	0.0070	0.0135	0.0098	0.0088	0.0108
	DR	-1.5803	-4.9334	1.7727	0.3538							
	TD	0.1448	-0.1250	0.4145	0.2912							
4	NF	-0.7752	-1.6575	0.1070	0.0847	0.0304	0.0078	0.0055	0.0111	0.0101	0.0091	0.0112
	DR	0.2879	-3.1859	3.7616	0.8703							
	TD	0.3764	0.0970	0.6558	0.0085							
5	NF	-1.0540	-2.0512	-0.0567	0.0384	0.0440	0.0091	0.0064	0.0129	0.0114	0.0103	0.0127
	DR	-1.7400	-5.6664	2.1865	0.3832							
	TD	0.5538	0.2380	0.8697	0.0007							
6	NF	-0.8593	-1.9512	0.2327	0.1223	0.0408	0.0099	0.0070	0.0141	0.0125	0.0113	0.0139
	DR	-1.1879	-5.4872	3.1115	0.5864							
	TD	0.4456	0.0997	0.7914	0.0118							
7	NF	-1.0392	-1.9925	-0.0859	0.0328	0.0346	0.0072	0.0050	0.0105	0.0109	0.0098	0.0121
	DR	0.4223	-3.3313	4.1758	0.8247							
	TD	0.2566	-0.0453	0.5585	0.0953							
8	NF	0.0699	-0.7215	0.8613	0.8619	0.0242	0.0076	0.0054	0.0108	0.0091	0.0082	0.0101
	DR	0.7646	-2.3516	3.8807	0.6290							
	TD	0.3666	0.1160	0.6173	0.0044							
9	NF	-0.5952	-1.4681	0.2778	0.1803	0.0338	0.0086	0.0061	0.0121	0.0100	0.0090	0.0111
	DR	-1.5406	-4.9777	1.8965	0.3778							
	TD	0.2968	0.0203	0.5733	0.0355							
10	NF	-0.6627	-1.6996	0.3742	0.2090	0.0406	0.0086	0.0060	0.0123	0.0119	0.0107	0.0132
	DR	-0.6899	-4.7725	3.3927	0.7393							
	TD	-0.0100	-0.3384	0.3184	0.9523							
11	NF	0.4687	-0.2827	1.2202	0.2201	0.0298	0.0068	0.0048	0.0096	0.0086	0.0078	0.0096
	DR	-1.2626	-4.2213	1.6961	0.4010							
	TD	0.0229	-0.2151	0.2609	0.8494							
12	NF	-0.4080	-1.2065	0.3905	0.3148	0.0296	0.0064	0.0045	0.0093	0.0091	0.0082	0.0101
	DR	-1.9222	-5.0661	1.2216	0.2293							
	TD	0.2875	0.0346	0.5404	0.0261							

13	NF	-0.9539	-1.8752	-0.0325	0.0425	0.0367	0.0082	0.0058	0.0117	0.0105	0.0095	0.0117
	DR	-2.8674	-6.4951	0.7602	0.1206							
	TD	0.6352	0.3434	0.9269	0.0000							
14	NF	-0.5799	-1.5522	0.3924	0.2409	0.0419	0.0098	0.0070	0.0138	0.0111	0.0100	0.0124
	DR	-1.0973	-4.9255	2.7309	0.5725							
	TD	0.1882	-0.1197	0.4962	0.2294							
15	NF	0.0287	-0.8204	0.8778	0.9470	0.0343	0.0071	0.0050	0.0102	0.0097	0.0088	0.0108
	DR	-2.8389	-6.1821	0.5044	0.0956							
	TD	0.0789	-0.1901	0.3478	0.5637							
16	NF	-1.0818	-2.0282	-0.1354	0.0253	0.0384	0.0083	0.0058	0.0118	0.0108	0.0098	0.0120
	DR	-0.7526	-4.4790	2.9738	0.6908							
	TD	0.2383	-0.0614	0.5381	0.1185							
17	NF	-0.9423	-1.8979	0.0133	0.0532	0.0490	0.0110	0.0080	0.0153	0.0109	0.0099	0.0121
	DR	-3.4875	-7.2501	0.2750	0.0691							
	TD	0.3387	0.0360	0.6413	0.0285							

NF: natural frequency, DR: damping ratio, TD: task duration,  $\bullet^*$ :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 780 nm optical density data, Blue shade means that identified significance exists not only in this 780 nm wavelength data but also in 805 or 830nm wavelength data, Red shade means that identified significance exists in all wavelength data.

**Table S8.** Entropy  $\sim$  Task duration +  $\omega_n + \zeta + (1|\text{subject})$ , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	NF	-1.1459	-2.1427	-0.1491	0.0245	0.0442	0.0075	0.0052	0.0109	0.0114	0.0103	0.0127
	DR	-2.2554	-6.1802	1.6695	0.2585							
2	TD	0.0713	-0.2445	0.3870	0.6567	0.0421	0.0081	0.0057	0.0116	0.0110	0.0099	0.0122
	NF	-0.3528	-1.3100	0.6044	0.4682							
3	DR	-0.4017	-4.1706	3.3672	0.8337	0.0291	0.0088	0.0063	0.0124	0.0101	0.0091	0.0112
	TD	0.1818	-0.1213	0.4850	0.2383							
4	NF	-0.7273	-1.6071	0.1525	0.1047	0.0324	0.0058	0.0039	0.0085	0.0094	0.0084	0.0104
	DR	-0.4613	-3.9254	3.0027	0.7931							
5	TD	-0.0409	-0.3195	0.2378	0.7727	0.0431	0.0089	0.0063	0.0125	0.0108	0.0097	0.0119
	NF	-0.7141	-1.5309	0.1027	0.0862							
6	DR	-3.6693	-6.8851	-0.4534	0.0256	0.0420	0.0075	0.0052	0.0109	0.0114	0.0103	0.0127
	TD	0.3840	0.1253	0.6426	0.0038							
7	NF	-0.2829	-1.2218	0.6560	0.5530	0.0369	0.0062	0.0043	0.0090	0.0096	0.0087	0.0107
	DR	-0.8547	-4.5516	2.8422	0.6489							
8	TD	0.2854	-0.0120	0.5828	0.0599	0.0247	0.0055	0.0038	0.0080	0.0085	0.0077	0.0094
	NF	-1.4137	-2.4112	-0.4162	0.0057							
9	DR	-1.0171	-4.9445	2.9104	0.6101	0.0370	0.0063	0.0043	0.0093	0.0106	0.0096	0.0118
	TD	0.1807	-0.1352	0.4967	0.2606							
10	NF	-0.6976	-1.5375	0.1424	0.1031	0.0344	0.0065	0.0044	0.0096	0.0110	0.0099	0.0122
	DR	-0.4823	-3.7896	2.8249	0.7739							
11	TD	0.0396	-0.2264	0.3056	0.7694	0.0435	0.0080	0.0055	0.0116	0.0122	0.0110	0.0135
	NF	-0.0478	-0.7903	0.6947	0.8991							
12	DR	-0.2224	-3.1458	2.7010	0.8809	0.0267	0.0054	0.0037	0.0080	0.0088	0.0079	0.0097
	TD	0.3976	0.1625	0.6328	0.0010							
13	NF	-0.8545	-1.8158	0.1068	0.0812	0.0310	0.0065	0.0045	0.0094	0.0098	0.0088	0.0109
	DR	0.4189	-3.3661	4.2039	0.8275							
14	TD	0.3024	-0.0021	0.6068	0.0516	0.0370	0.0063	0.0043	0.0093	0.0106	0.0096	0.0118
	NF	-1.3942	-2.4600	-0.3284	0.0106							
15	DR	-0.1031	-4.2996	4.0933	0.9614	0.0449	0.0090	0.0064	0.0127	0.0107	0.0097	0.0119
	TD	0.1334	-0.2042	0.4709	0.4368							
16	NF	0.7252	-0.0412	1.4915	0.0635	0.0344	0.0055	0.0037	0.0083	0.0099	0.0089	0.0110
	DR	-1.3963	-4.4137	1.6211	0.3626							
17	TD	0.1280	-0.1148	0.3707	0.2998	0.0416	0.0091	0.0065	0.0128	0.0103	0.0093	0.0115
	NF	-0.3368	-1.1910	0.5174	0.4377							
18	DR	-2.1673	-5.5306	1.1960	0.2053	0.0416	0.0091	0.0065	0.0128	0.0103	0.0093	0.0115
	TD	0.2039	-0.0667	0.4744	0.1389							
19	NF	-0.5726	-1.5007	0.3554	0.2251	0.0370	0.0063	0.0043	0.0093	0.0106	0.0096	0.0118
	DR	-0.9849	-4.6390	2.6691	0.5956							
20	TD	0.1161	-0.1778	0.4101	0.4367	0.0449	0.0090	0.0064	0.0127	0.0107	0.0097	0.0119
	NF	-1.5632	-2.4999	-0.6265	0.0012							
21	DR	-0.4388	-4.1269	3.2493	0.8147	0.0344	0.0055	0.0037	0.0083	0.0099	0.0089	0.0110
	TD	0.1677	-0.1290	0.4643	0.2664							
22	NF	-0.3621	-1.2257	0.5015	0.4093	0.0416	0.0091	0.0065	0.0128	0.0103	0.0093	0.0115
	DR	-3.1823	-6.5827	0.2180	0.0664							
23	TD	0.0341	-0.2394	0.3076	0.8059	0.0416	0.0091	0.0065	0.0128	0.0103	0.0093	0.0115
	NF	-0.8043	-1.7051	0.0965	0.0798							

17	DR	-3.6059	-7.1527	-0.0591	0.0463	0.0465	0.0099	0.0071	0.0139	0.0109	0.0098	0.0121
	TD	0.1268	-0.1585	0.4121	0.3818							
	NF	-0.9102	-1.8622	0.0417	0.0608							
	DR	0.2291	-3.5191	3.9773	0.9042							
	TD	0.0402	-0.2613	0.3417	0.7929							

NF: natural frequency, DR: damping ratio, TD: task duration,  $\bullet^*$ :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 805 nm wavelength data, Blue shade means that identified significance exists not only in this 805 nm wavelength data but also in 780 or 830nm wavelength data, Red shade means that identified significance exists in all wavelength data.

**Table S9. Entropy  $\sim$  Task duration+ $\omega_n + \zeta + (1|\text{subject})$ , 830 nm optical density data statistical results.**

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	NF	-0.5180	-1.4513	0.4154	0.2751	0.0373	0.0067	0.0045	0.0097	0.0107	0.0096	0.0119
	DR	-2.2619	-5.9368	1.4131	0.2263							
	TD	0.0695	-0.2261	0.3651	0.6433							
2	NF	-0.0179	-0.9773	0.9416	0.9707	0.0343	0.0078	0.0054	0.0112	0.0110	0.0099	0.0122
	DR	-0.4736	-4.2512	3.3041	0.8050							
	TD	0.2261	-0.0778	0.5299	0.1439							
3	NF	-0.5136	-1.2677	0.2405	0.1808	0.0232	0.0061	0.0043	0.0088	0.0086	0.0078	0.0096
	DR	0.7877	-2.1815	3.7568	0.6014							
	TD	0.0123	-0.2265	0.2511	0.9193							
4	NF	-0.8239	-1.5891	-0.0587	0.0350	0.0297	0.0046	0.0031	0.0070	0.0088	0.0079	0.0097
	DR	-3.4965	-6.5094	-0.4836	0.0232							
	TD	0.3606	0.1183	0.6030	0.0037							
5	NF	-0.6322	-1.5670	0.3027	0.1839	0.0398	0.0078	0.0055	0.0112	0.0107	0.0096	0.0119
	DR	-0.3037	-3.9846	3.3772	0.8709							
	TD	0.3343	0.0382	0.6304	0.0271							
6	NF	-0.9333	-1.8432	-0.0233	0.0445	0.0334	0.0062	0.0042	0.0092	0.0104	0.0094	0.0116
	DR	-1.4144	-4.9972	2.1684	0.4372							
	TD	0.3963	0.1082	0.6845	0.0073							
7	NF	-0.7009	-1.5204	0.1185	0.0932	0.0308	0.0048	0.0032	0.0074	0.0094	0.0085	0.0104
	DR	0.0771	-3.1495	3.3036	0.9625							
	TD	0.0092	-0.2503	0.2688	0.9442							
8	NF	-0.0138	-0.6620	0.6344	0.9666	0.0233	0.0047	0.0032	0.0069	0.0074	0.0067	0.0082
	DR	-0.9289	-3.4810	1.6233	0.4737							
	TD	0.3621	0.1568	0.5673	0.0006							
9	NF	-0.7048	-1.4818	0.0722	0.0752	0.0282	0.0050	0.0033	0.0074	0.0089	0.0080	0.0099
	DR	0.1350	-2.9244	3.1943	0.9307							
	TD	0.3163	0.0702	0.5624	0.0120							
10	NF	-0.6814	-1.6207	0.2578	0.1541	0.0318	0.0057	0.0038	0.0086	0.0108	0.0097	0.0119
	DR	0.3880	-3.3100	4.0860	0.8363							
	TD	0.1424	-0.1551	0.4398	0.3464							
11	NF	0.5076	-0.1812	1.1964	0.1477	0.0239	0.0052	0.0036	0.0076	0.0079	0.0071	0.0088
	DR	-0.6079	-3.3200	2.1041	0.6589							
	TD	0.1861	-0.0321	0.4042	0.0941							
12	NF	-0.2131	-0.9622	0.5360	0.5754	0.0258	0.0044	0.0029	0.0068	0.0086	0.0077	0.0095
	DR	-0.9669	-3.9165	1.9826	0.5187							
	TD	0.2618	0.0245	0.4990	0.0308							
13	NF	-0.1818	-0.9722	0.6086	0.6506	0.0298	0.0051	0.0034	0.0076	0.0091	0.0082	0.0100
	DR	-0.5870	-3.6992	2.5252	0.7103							
	TD	0.1863	-0.0641	0.4366	0.1439							
14	NF	-0.4716	-1.3868	0.4436	0.3108	0.0339	0.0065	0.0045	0.0096	0.0105	0.0094	0.0116
	DR	-1.1622	-4.7657	2.4413	0.5255							
	TD	0.2426	-0.0473	0.5325	0.1004							
15	NF	-0.5074	-1.3467	0.3319	0.2346	0.0291				0.0096	0.0087	0.0106
	DR	-2.4197	-5.7243	0.8849	0.1503							
	TD	0.1755	-0.0903	0.4413	0.1943							
16	NF	-1.0418	-1.9317	-0.1519	0.0220	0.0362	0.0073	0.0051	0.0105	0.0102	0.0092	0.0113
	DR	-2.0809	-5.5848	1.4229	0.2429							
	TD	0.1280	-0.1539	0.4098	0.3717							
17	NF	-0.8872	-1.8136	0.0393	0.0604	0.0436	0.0101	0.0072	0.0140	0.0106	0.0096	0.0118
	DR	-2.8585	-6.5062	0.7892	0.1238							
	TD	0.1812	-0.1123	0.4746	0.2248							

NF: natural frequency, DR: damping ratio, TD: task duration,  $\bullet^*$ :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength data, Blue shade means that identified significance exists not only in this 830 nm wavelength data but also in 780 or 805nm wavelength data, Red shade means that identified significance exists in all wavelength data. Blank in random effect column means there is no random effect.

**Table S10.** Signal amplitude ~ State+(1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0025	0.0013	0.0038	0.0001	-0.0013			0.0065	0.0061	0.0070	
2	State	0.0014	0.0004	0.0023	0.0069	-0.0007			0.0050	0.0046	0.0053	
3	State	0.0003	-0.0015	0.0021	0.7370	-0.0002			0.0093	0.0086	0.0099	
4	State	0.0025	0.0013	0.0037	0.0000	-0.0013			0.0061	0.0057	0.0065	
5	State	0.0010	-0.0002	0.0022	0.0911	-0.0005			0.0060	0.0056	0.0065	
6	State	0.0000	-0.0016	0.0016	0.9918	0.0000			0.0081	0.0075	0.0086	
7	State	0.0009	-0.0001	0.0019	0.0691	-0.0004			0.0049	0.0046	0.0053	
8	State	0.0000	-0.0011	0.0012	0.9601	0.0000			0.0058	0.0054	0.0062	
9	State	0.0001	-0.0010	0.0013	0.8048	-0.0001			0.0057	0.0053	0.0061	
10	State	0.0016	0.0002	0.0029	0.0217	-0.0008			0.0067	0.0063	0.0072	
11	State	0.0015	0.0005	0.0025	0.0039	-0.0007			0.0051	0.0047	0.0054	
12	State	-0.0005	-0.0016	0.0006	0.3553	0.0003			0.0056	0.0052	0.0060	
13	State	0.0010	0.0000	0.0020	0.0404	-0.0005			0.0051	0.0047	0.0054	
14	State	0.0008	-0.0001	0.0018	0.0807	-0.0004			0.0048	0.0045	0.0052	
15	State	0.0004	-0.0006	0.0015	0.4350	-0.0002			0.0053	0.0049	0.0056	
16	State	0.0004	-0.0006	0.0014	0.4003	-0.0002			0.0050	0.0047	0.0054	
17	State	0.0008	-0.0002	0.0018	0.1264	-0.0004			0.0050	0.0046	0.0053	

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Red shade means that identified significance exists in all wavelength data. There is no random effect.

**Table S11.** Signal amplitude ~ State+(1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0038	0.0024	0.0052	0.0000	-0.0019			0.0069	0.0065	0.0074	
2	State	0.0030	0.0020	0.0041	0.0000	-0.0015			0.0053	0.0050	0.0057	
3	State	0.0022	0.0003	0.0040	0.0208	-0.0011			0.0093	0.0087	0.0100	
4	State	0.0040	0.0027	0.0054	0.0000	-0.0020			0.0068	0.0064	0.0073	
5	State	0.0028	0.0015	0.0041	0.0000	-0.0013			0.0066	0.0062	0.0071	
6	State	0.0027	0.0012	0.0043	0.0005	-0.0014			0.0077	0.0072	0.0083	
7	State	0.0013	0.0003	0.0023	0.0137	-0.0006			0.0052	0.0049	0.0056	
8	State	0.0011	-0.0002	0.0023	0.0902	-0.0005			0.0063	0.0058	0.0067	
9	State	0.0019	0.0007	0.0031	0.0023	-0.0009			0.0061	0.0057	0.0065	
10	State	0.0020	0.0006	0.0034	0.0055	-0.0010			0.0070	0.0065	0.0075	
11	State	0.0024	0.0013	0.0035	0.0000	-0.0012			0.0054	0.0051	0.0058	
12	State	0.0005	-0.0008	0.0017	0.4597	-0.0002			0.0062	0.0058	0.0067	
13	State	0.0025	0.0014	0.0036	0.0000	-0.0012			0.0057	0.0053	0.0061	
14	State	0.0011	0.0001	0.0021	0.0397	-0.0005			0.0052	0.0048	0.0055	
15	State	0.0012	0.0000	0.0023	0.0445	-0.0006			0.0058	0.0054	0.0062	
16	State	0.0015	0.0003	0.0026	0.0108	-0.0007			0.0057	0.0054	0.0062	
17	State	0.0020	0.0009	0.0032	0.0004	-0.0010			0.0057	0.0053	0.0061	

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Blue shade means that identified significance exists not only in this 805 nm wavelength data but also in 830nm wavelength data, Red shade means that identified significance exists in all wavelength data. There is no random effect.

**Table S12.** Signal amplitude ~ State+(1|subject) , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0045	0.0030	0.0060	0.0000	-0.0022			0.0077	0.0071	0.0082	
2	State	0.0036	0.0025	0.0048	0.0000	-0.0018			0.0058	0.0054	0.0062	
3	State	0.0028	0.0009	0.0046	0.0038	-0.0014			0.0094	0.0088	0.0101	
4	State	0.0045	0.0030	0.0060	0.0000	-0.0022			0.0077	0.0072	0.0082	
5	State	0.0035	0.0021	0.0049	0.0000	-0.0017			0.0070	0.0066	0.0075	
6	State	0.0032	0.0016	0.0048	0.0001	-0.0016			0.0080	0.0074	0.0086	

7	State	0.0017	0.0005	0.0028	0.0043	-0.0008		0.0057	0.0053	0.0061
8	State	0.0014	0.0001	0.0027	0.0361	-0.0007		0.0066	0.0062	0.0071
9	State	0.0024	0.0011	0.0037	0.0004	-0.0012		0.0066	0.0062	0.0071
10	State	0.0024	0.0009	0.0039	0.0013	-0.0012		0.0074	0.0069	0.0079
11	State	0.0027	0.0016	0.0039	0.0000	-0.0013		0.0059	0.0055	0.0063
12	State	0.0007	-0.0006	0.0021	0.2655	-0.0004		0.0066	0.0062	0.0071
13	State	0.0028	0.0016	0.0040	0.0000	-0.0014		0.0062	0.0058	0.0066
14	State	0.0013	0.0002	0.0024	0.0226	-0.0006		0.0056	0.0053	0.0060
15	State	0.0014	0.0002	0.0026	0.0243	-0.0007		0.0062	0.0058	0.0067
16	State	0.0018	0.0006	0.0030	0.0033	-0.0009		0.0061	0.0057	0.0065
17	State	0.0022	0.0010	0.0034	0.0003	-0.0011		0.0061	0.0057	0.0066

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength data, Blue shade means that identified significance exists not only in this 830 nm wavelength data but also in 805nm wavelength data, Red shade means that identified significance exists in all wavelength density data. There is no random effect.

**Table S13.** Signal amplitude~ Rest duration+ (1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	-0.1302	-0.3139	0.0535	0.1637	-0.0001			0.0068	0.0061	0.0075	
2	RD	-0.0782	-0.2200	0.0636	0.2780	0.0000			0.0052	0.0047	0.0058	
3	RD	-0.0899	-0.3750	0.1952	0.5347	0.0006			0.0105	0.0095	0.0116	
4	RD	-0.0720	-0.2470	0.1029	0.4178	-0.0006			0.0064	0.0058	0.0071	
5	RD	-0.1025	-0.2678	0.0629	0.2232	0.0004			0.0061	0.0055	0.0067	
6	RD	-0.1488	-0.3966	0.0991	0.2379	0.0013			0.0091	0.0083	0.0101	
7	RD	-0.0574	-0.1982	0.0833	0.4220	0.0001			0.0052	0.0047	0.0057	
8	RD	-0.1272	-0.2841	0.0297	0.1114	0.0011			0.0058	0.0052	0.0064	
9	RD	-0.1455	-0.3064	0.0154	0.0761	0.0012			0.0059	0.0054	0.0065	
10	RD	-0.1239	-0.3315	0.0837	0.2405	0.0003			0.0076	0.0069	0.0084	
11	RD	-0.0850	-0.2239	0.0539	0.2288	0.0000			0.0051	0.0046	0.0056	
12	RD	-0.1054	-0.2577	0.0469	0.1740	0.0012			0.0056	0.0051	0.0062	
13	RD	-0.1114	-0.2550	0.0322	0.1275	0.0005			0.0053	0.0048	0.0058	
14	RD	-0.0544	-0.1927	0.0839	0.4388	0.0001			0.0051	0.0046	0.0056	
15	RD	-0.0696	-0.2164	0.0772	0.3511	0.0004			0.0054	0.0049	0.0060	
16	RD	-0.0391	-0.1806	0.1024	0.5865	0.0002			0.0052	0.0047	0.0058	
17	RD	-0.0399	-0.1800	0.1003	0.5755	0.0000			0.0052	0.0047	0.0057	

RD: rest duration, \* :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Signal amplitude calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, There is no random effect.

**Table S14.** Signal amplitude~ Rest duration+ (1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	-0.0968	-0.2922	0.0985	0.3293	-0.0010			0.0072	0.0065	0.0079	
2	RD	-0.0666	-0.2105	0.0774	0.3631	-0.0009			0.0053	0.0048	0.0059	
3	RD	-0.0950	-0.3814	0.1915	0.5140	-0.0002			0.0106	0.0096	0.0116	
4	RD	-0.0493	-0.2423	0.1438	0.6151	-0.0015			0.0071	0.0064	0.0078	
5	RD	-0.0906	-0.2700	0.0888	0.3204	-0.0005			0.0066	0.0060	0.0073	
6	RD	-0.1489	-0.3807	0.0829	0.2068	0.0000			0.0085	0.0077	0.0094	
7	RD	-0.0593	-0.2089	0.0904	0.4357	-0.0001			0.0055	0.0050	0.0061	
8	RD	-0.1124	-0.2826	0.0578	0.1944	0.0005			0.0063	0.0057	0.0069	
9	RD	-0.1208	-0.2923	0.0506	0.1662	0.0002			0.0063	0.0057	0.0070	
10	RD	-0.1052	-0.3202	0.1098	0.3357	0.0000			0.0079	0.0072	0.0087	
11	RD	-0.0799	-0.2306	0.0709	0.2973	-0.0005			0.0056	0.0050	0.0061	
12	RD	-0.0944	-0.2659	0.0771	0.2790	0.0006			0.0063	0.0057	0.0070	
13	RD	-0.0935	-0.2513	0.0643	0.2442	-0.0004			0.0058	0.0053	0.0064	
14	RD	-0.0548	-0.2018	0.0922	0.4632	0.0000			0.0054	0.0049	0.0060	
15	RD	-0.0444	-0.2096	0.1207	0.5964	-0.0002			0.0061	0.0055	0.0067	
16	RD	-0.0218	-0.1810	0.1373	0.7868	-0.0005			0.0059	0.0053	0.0065	
17	RD	-0.0522	-0.2077	0.1034	0.5090	-0.0005			0.0057	0.0052	0.0063	

RD: rest duration,  $\bullet^* : \times 10^{-3}$ , SD: standard deviation, CI: confident interval, Signal amplitude calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, There is no random effect.

**Table S15.** Signal amplitude~ Rest duration+ (1|subject) , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	-0.0998	-0.3130	0.1134	0.3572	-0.0013			0.0079	0.0071	0.0087	
2	RD	-0.0771	-0.2332	0.0790	0.3313	-0.0011			0.0058	0.0052	0.0063	
3	RD	-0.1047	-0.3930	0.1836	0.4747	-0.0004			0.0106	0.0096	0.0117	
4	RD	-0.0493	-0.2649	0.1664	0.6528	-0.0018			0.0079	0.0072	0.0088	
5	RD	-0.0913	-0.2800	0.0974	0.3413	-0.0009			0.0070	0.0063	0.0077	
6	RD	-0.1467	-0.3845	0.0911	0.2252	-0.0003			0.0088	0.0079	0.0097	
7	RD	-0.0555	-0.2185	0.1075	0.5026	-0.0003			0.0060	0.0054	0.0066	
8	RD	-0.1042	-0.2830	0.0746	0.2519	0.0003			0.0066	0.0060	0.0073	
9	RD	-0.1187	-0.3054	0.0680	0.2114	-0.0001			0.0069	0.0062	0.0076	
10	RD	-0.1043	-0.3253	0.1167	0.3532	-0.0002			0.0081	0.0074	0.0090	
11	RD	-0.0780	-0.2417	0.0858	0.3489	-0.0006			0.0060	0.0055	0.0067	
12	RD	-0.0824	-0.2654	0.1005	0.3753	0.0004			0.0067	0.0061	0.0074	
13	RD	-0.0826	-0.2517	0.0865	0.3365	-0.0006			0.0062	0.0056	0.0069	
14	RD	-0.0420	-0.2005	0.1165	0.6022	-0.0003			0.0058	0.0053	0.0064	
15	RD	-0.0448	-0.2218	0.1323	0.6186	-0.0003			0.0065	0.0059	0.0072	
16	RD	-0.0183	-0.1858	0.1493	0.8301	-0.0007			0.0062	0.0056	0.0068	
17	RD	-0.0529	-0.2188	0.1130	0.5303	-0.0006			0.0061	0.0055	0.0067	

RD: rest duration,  $\bullet^* : \times 10^{-3}$ , SD: standard deviation, CI: confident interval, Signal amplitude calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, There is no random effect

**Table S16.** Signal amplitude ~ Task duration+ $\omega_n + \zeta$ +(1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	NF	0.0006	0.0000	0.0011	0.0385	-0.0008				0.0061	0.0055	0.0067
	DR	0.0000	-0.0021	0.0021	0.9937							
	TD	0.0000	-0.0001	0.0002	0.6178							
2	NF	0.0004	0.0000	0.0008	0.0483	-0.0004				0.0046	0.0042	0.0051
	DR	-0.0004	-0.0020	0.0012	0.6197							
	TD	0.0000	-0.0001	0.0002	0.7174							
3	NF	0.0004	-0.0001	0.0010	0.1433	-0.0004	0.0041	0.0028	0.0060	0.0066	0.0060	0.0074
	DR	-0.0010	-0.0033	0.0013	0.3840							
	TD	0.0000	-0.0002	0.0002	0.8093							
4	NF	0.0007	0.0002	0.0012	0.0055	-0.0001				0.0056	0.0051	0.0062
	DR	-0.0005	-0.0024	0.0014	0.6045							
	TD	0.0000	-0.0002	0.0001	0.7815							
5	NF	0.0008	0.0003	0.0013	0.0025	-0.0024				0.0058	0.0052	0.0064
	DR	0.0001	-0.0018	0.0021	0.8886							
	TD	0.0000	-0.0001	0.0002	0.6266							
6	NF	0.0004	-0.0001	0.0009	0.1304	-0.0020	0.0037	0.0025	0.0053	0.0056	0.0050	0.0062
	DR	-0.0003	-0.0022	0.0017	0.7854							
	TD	0.0001	0.0000	0.0003	0.1646							
7	NF	0.0007	0.0003	0.0010	0.0002	-0.0008	0.0020	0.0013	0.0031	0.0040	0.0036	0.0044
	DR	-0.0007	-0.0021	0.0007	0.3211							
	TD	0.0000	-0.0001	0.0001	0.9532							
8	NF	0.0008	0.0003	0.0013	0.0012	-0.0030				0.0056	0.0051	0.0062
	DR	-0.0001	-0.0021	0.0018	0.8940							
	TD	0.0001	-0.0001	0.0002	0.3535							
9	NF	0.0007	0.0003	0.0011	0.0005	-0.0046	0.0021	0.0013	0.0033	0.0047	0.0043	0.0052
	DR	0.0015	-0.0001	0.0031	0.0718							
	TD	0.0001	0.0000	0.0002	0.1313							
10	NF	0.0009	0.0004	0.0013	0.0005	-0.0014				0.0054	0.0049	0.0060
	DR	-0.0007	-0.0026	0.0011	0.4494							
	TD	0.0000	-0.0001	0.0002	0.6360							
11	NF	0.0007	0.0003	0.0011	0.0016	-0.0023				0.0048	0.0044	0.0053
	DR	0.0008	-0.0009	0.0025	0.3375							
	TD	0.0000	-0.0001	0.0001	0.8275							
12	NF	0.0010	0.0006	0.0014	0.0000	-0.0047	0.0022	0.0014	0.0035	0.0047	0.0042	0.0052
	DR	0.0008	-0.0008	0.0024	0.3002							



13	TD	0.0001	-0.0001	0.0002	0.4218	-0.0038				0.0045	0.0041	0.0050
	NF	0.0009	0.0005	0.0013	0.0000							
	DR	0.0012	-0.0004	0.0027	0.1354							
	TD	0.0000	-0.0001	0.0002	0.5621							
14	NF	0.0006	0.0003	0.0010	0.0010	-0.0011				0.0044	0.0040	0.0048
	DR	-0.0004	-0.0019	0.0011	0.6121							
	TD	0.0000	-0.0001	0.0001	0.9852							
	NF	0.0009	0.0004	0.0013	0.0001							
15	DR	0.0004	-0.0013	0.0021	0.6140	-0.0029				0.0049	0.0044	0.0054
	TD	0.0000	-0.0001	0.0001	0.9227							
	NF	0.0012	0.0008	0.0016	0.0000							
	DR	0.0012	-0.0003	0.0027	0.1245							
16	TD	0.0000	-0.0002	0.0001	0.5869	-0.0041				0.0044	0.0040	0.0049
	NF	0.0010	0.0006	0.0013	0.0000							
	DR	0.0009	-0.0005	0.0023	0.2160							
	TD	0.0000	-0.0001	0.0001	0.6127							
17	NF	0.0010	0.0006	0.0013	0.0000	-0.0032	0.0018	0.0012	0.0029	0.0041	0.0037	0.0046
	DR	0.0009	-0.0005	0.0023	0.2160							
	TD	0.0000	-0.0001	0.0001	0.6127							
	NF	0.0009	0.0005	0.0013	0.0000							

**Table S17.** Signal amplitude  $\sim$  Task duration +  $\omega_n + \zeta + (1|\text{subject})$  , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect				Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)		
			Lower	Upper				Lower	Upper		Lower	Upper	
1	NF	0.0009	0.0003	0.0014	0.0036	0.0006				0.0065	0.0059	0.0072	
	DR	-0.0009	-0.0032	0.0013	0.4132								
	TD	0.0000	-0.0002	0.0002	0.7919								
2	NF	0.0008	0.0003	0.0012	0.0006	0.0009				0.0051	0.0046	0.0057	
	DR	-0.0013	-0.0031	0.0004	0.1329								
	TD	0.0000	-0.0002	0.0001	0.5723								
3	NF	0.0007	0.0001	0.0013	0.0227	0.0013	0.0037	0.0025	0.0056	0.0068	0.0062	0.0076	
	DR	-0.0021	-0.0044	0.0003	0.0816								
	TD	0.0000	-0.0002	0.0002	0.8082								
4	NF	0.0008	0.0003	0.0014	0.0037	0.0017				0.0064	0.0058	0.0070	
	DR	-0.0014	-0.0036	0.0008	0.2148								
	TD	-0.0001	-0.0002	0.0001	0.4139								
5	NF	0.0011	0.0006	0.0017	0.0001	-0.0012				0.0063	0.0058	0.0070	
	DR	-0.0007	-0.0029	0.0015	0.5458								
	TD	0.0000	-0.0002	0.0002	0.8257								
6	NF	0.0007	0.0002	0.0012	0.0083	0.0001	0.0029	0.0019	0.0045	0.0060	0.0054	0.0066	
	DR	-0.0012	-0.0033	0.0008	0.2355								
	TD	0.0000	-0.0001	0.0002	0.6457								
7	NF	0.0007	0.0004	0.0011	0.0001	-0.0004	0.0022	0.0015	0.0034	0.0042	0.0038	0.0047	
	DR	-0.0010	-0.0025	0.0005	0.1752								
	TD	0.0000	-0.0001	0.0001	0.8244								
8	NF	0.0011	0.0006	0.0016	0.0000	-0.0022				0.0059	0.0054	0.0066	
	DR	-0.0008	-0.0029	0.0012	0.4309								
	TD	0.0000	-0.0001	0.0002	0.7573								
9	NF	0.0011	0.0006	0.0015	0.0000	-0.0031	0.0024	0.0015	0.0037	0.0050	0.0045	0.0055	
	DR	0.0005	-0.0012	0.0023	0.5286								
	TD	0.0000	-0.0001	0.0002	0.6496								
10	NF	0.0009	0.0004	0.0014	0.0006	-0.0009				0.0057	0.0052	0.0063	
	DR	-0.0009	-0.0029	0.0011	0.3719								
	TD	0.0000	-0.0001	0.0002	0.8902								
11	NF	0.0009	0.0004	0.0013	0.0001	-0.0018				0.0051	0.0046	0.0056	
	DR	0.0004	-0.0013	0.0022	0.6244								
	TD	0.0000	-0.0002	0.0001	0.8304								
12	NF	0.0013	0.0008	0.0017	0.0000	-0.0041	0.0024	0.0015	0.0038	0.0052	0.0047	0.0058	
	DR	0.0004	-0.0014	0.0022	0.6607								
	TD	0.0000	-0.0001	0.0002	0.8992								
13	NF	0.0012	0.0008	0.0017	0.0000	-0.0025				0.0052	0.0047	0.0058	
	DR	0.0003	-0.0015	0.0021	0.7305								
	TD	0.0000	-0.0002	0.0001	0.7545								
14	NF	0.0007	0.0003	0.0011	0.0011	-0.0007				0.0048	0.0043	0.0053	
	DR	-0.0007	-0.0024	0.0009	0.3883								
	TD	0.0000	-0.0001	0.0001	0.8345								
15	NF	0.0011	0.0006	0.0016	0.0000	-0.0024				0.0052	0.0048	0.0058	
	DR	0.0001	-0.0017	0.0019	0.8846								
	TD	0.0000	-0.0002	0.0001	0.5489								
16	NF	0.0014	0.0010	0.0019	0.0000	-0.0037				0.0051	0.0046	0.0057	
	DR	0.0010	-0.0007	0.0028	0.2583								

17	TD	-0.0001	-0.0002	0.0001	0.2490	-0.0028		0.0052	0.0047	0.0058
	NF	0.0012	0.0008	0.0017	0.0000					
	DR	0.0007	-0.0011	0.0025	0.4165					
	TD	-0.0001	-0.0002	0.0001	0.4512					

NF: natural frequency, DR: damping ratio, TD: task duration, SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 805 nm wavelength data, Blue shade means that identified significance exists not only in this 805 nm wavelength data but also in 830nm wavelength data, Red shade means that identified significance exists in all wavelength data. Blank in random effect column means there is no random effect.

**Table S18.** Signal amplitude  $\sim$  Task duration +  $\omega_n + \zeta + (1|\text{subject})$ , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	NF	0.0010	0.0003	0.0016	0.0027	0.0008				0.0073	0.0066	0.0080
	DR	-0.0010	-0.0035	0.0015	0.4194							
	TD	0.0000	-0.0002	0.0002	0.6729							
2	NF	0.0010	0.0005	0.0015	0.0001	0.0006				0.0056	0.0050	0.0061
	DR	-0.0013	-0.0032	0.0006	0.1936							
	TD	0.0000	-0.0002	0.0001	0.5622							
3	NF	0.0008	0.0002	0.0014	0.0132	0.0015	0.0036	0.0023	0.0055	0.0071	0.0064	0.0079
	DR	-0.0022	-0.0046	0.0002	0.0766							
	TD	0.0000	-0.0002	0.0002	0.7688							
4	NF	0.0009	0.0003	0.0015	0.0054	0.0021				0.0072	0.0065	0.0080
	DR	-0.0017	-0.0042	0.0008	0.1814							
	TD	-0.0001	-0.0003	0.0001	0.3868							
5	NF	0.0013	0.0007	0.0019	0.0000	-0.0006				0.0068	0.0061	0.0075
	DR	-0.0011	-0.0034	0.0013	0.3653							
	TD	0.0000	-0.0002	0.0001	0.6712							
6	NF	0.0009	0.0003	0.0014	0.0024	0.0002	0.0029	0.0018	0.0046	0.0063	0.0057	0.0070
	DR	-0.0014	-0.0035	0.0008	0.2115							
	TD	0.0000	-0.0002	0.0002	0.8456							
7	NF	0.0008	0.0004	0.0012	0.0001	0.0000	0.0023	0.0015	0.0035	0.0047	0.0042	0.0052
	DR	-0.0014	-0.0030	0.0003	0.0990							
	TD	0.0000	-0.0002	0.0001	0.6281							
8	NF	0.0012	0.0006	0.0018	0.0000	-0.0020				0.0064	0.0058	0.0070
	DR	-0.0010	-0.0032	0.0012	0.3749							
	TD	0.0000	-0.0002	0.0002	0.9366							
9	NF	0.0012	0.0007	0.0017	0.0000	-0.0029	0.0024	0.0015	0.0039	0.0055	0.0050	0.0062
	DR	0.0005	-0.0014	0.0024	0.6090							
	TD	0.0000	-0.0001	0.0002	0.8728							
10	NF	0.0010	0.0005	0.0016	0.0002	-0.0006				0.0063	0.0057	0.0070
	DR	-0.0012	-0.0034	0.0009	0.2603							
	TD	0.0000	-0.0002	0.0002	0.9081							
11	NF	0.0010	0.0005	0.0014	0.0001	-0.0015				0.0055	0.0050	0.0061
	DR	0.0003	-0.0016	0.0022	0.7447							
	TD	0.0000	-0.0002	0.0001	0.7160							
12	NF	0.0014	0.0009	0.0019	0.0000	-0.0040	0.0025	0.0016	0.0040	0.0056	0.0050	0.0062
	DR	0.0004	-0.0015	0.0023	0.6864							
	TD	0.0000	-0.0002	0.0001	0.8787							
13	NF	0.0013	0.0008	0.0018	0.0000	-0.0022				0.0058	0.0052	0.0064
	DR	0.0002	-0.0018	0.0022	0.8604							
	TD	0.0000	-0.0002	0.0001	0.6005							
14	NF	0.0009	0.0004	0.0013	0.0003	-0.0005				0.0052	0.0047	0.0058
	DR	-0.0010	-0.0028	0.0008	0.2671							
	TD	0.0000	-0.0002	0.0001	0.6107							
15	NF	0.0012	0.0007	0.0017	0.0000	-0.0025				0.0056	0.0051	0.0062
	DR	0.0001	-0.0018	0.0020	0.9073							
	TD	0.0000	-0.0002	0.0001	0.5335							
16	NF	0.0015	0.0010	0.0020	0.0000	-0.0035				0.0055	0.0049	0.0060
	DR	0.0009	-0.0010	0.0027	0.3692							
	TD	-0.0001	-0.0002	0.0001	0.2030							
17	NF	0.0013	0.0008	0.0018	0.0000	-0.0025				0.0057	0.0052	0.0063
	DR	0.0003	-0.0016	0.0023	0.7472							
	TD	-0.0001	-0.0002	0.0001	0.4381							

NF: natural frequency, DR: damping ratio, TD: task duration, SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength data. Blue shade means that identified significance exists not only in this 830 nm wavelength data but also in 805nm wavelength data, Red shade means that identified significance exists in all wavelength data.

**Table S19.** Beta ~ State+(1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0029	0.0014	0.0044	0.0001	-0.0015			0.0074	0.0069	0.0080	
2	State	0.0016	0.0004	0.0027	0.0070	-0.0008			0.0057	0.0053	0.0061	
3	State	0.0004	-0.0017	0.0025	0.7363	-0.0002			0.0106	0.0099	0.0114	
4	State	0.0029	0.0015	0.0043	0.0000	-0.0014			0.0070	0.0065	0.0075	
5	State	0.0012	-0.0002	0.0025	0.0913	-0.0006			0.0069	0.0064	0.0074	
6	State	0.0000	-0.0018	0.0018	0.9896	0.0000			0.0092	0.0086	0.0099	
7	State	0.0010	-0.0001	0.0021	0.0694	-0.0005			0.0056	0.0052	0.0060	
8	State	0.0000	-0.0013	0.0013	0.9636	0.0000			0.0067	0.0062	0.0071	
9	State	0.0002	-0.0011	0.0014	0.8093	-0.0001			0.0065	0.0061	0.0070	
10	State	0.0018	0.0003	0.0033	0.0218	-0.0009			0.0077	0.0072	0.0083	
11	State	0.0017	0.0005	0.0028	0.0039	-0.0008			0.0058	0.0054	0.0062	
12	State	-0.0006	-0.0019	0.0007	0.3515	0.0003			0.0064	0.0059	0.0068	
13	State	0.0012	0.0001	0.0023	0.0405	-0.0006			0.0058	0.0054	0.0062	
14	State	0.0010	-0.0001	0.0021	0.0813	-0.0005			0.0055	0.0051	0.0059	
15	State	0.0005	-0.0007	0.0017	0.4373	-0.0002			0.0060	0.0056	0.0065	
16	State	0.0005	-0.0007	0.0016	0.4028	-0.0002			0.0058	0.0054	0.0062	
17	State	0.0009	-0.0003	0.0020	0.1276	-0.0004			0.0057	0.0053	0.0061	

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Red shade means that identified significance exists in all wavelength data. There is no random effect.

**Table S20.** Beta ~ State+(1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0044	0.0028	0.0059	0.0000	-0.0022			0.0079	0.0074	0.0085	
2	State	0.0035	0.0023	0.0047	0.0000	-0.0017			0.0061	0.0057	0.0065	
3	State	0.0025	0.0004	0.0046	0.0207	-0.0013			0.0107	0.0100	0.0114	
4	State	0.0046	0.0030	0.0061	0.0000	-0.0023			0.0078	0.0073	0.0084	
5	State	0.0032	0.0017	0.0047	0.0000	-0.0015			0.0076	0.0071	0.0081	
6	State	0.0031	0.0014	0.0049	0.0005	-0.0016			0.0088	0.0083	0.0095	
7	State	0.0015	0.0003	0.0027	0.0138	-0.0007			0.0060	0.0056	0.0064	
8	State	0.0012	-0.0002	0.0026	0.0908	-0.0006			0.0072	0.0067	0.0077	
9	State	0.0021	0.0008	0.0035	0.0023	-0.0010			0.0070	0.0065	0.0075	
10	State	0.0022	0.0007	0.0038	0.0055	-0.0011			0.0080	0.0075	0.0086	
11	State	0.0027	0.0015	0.0040	0.0000	-0.0013			0.0062	0.0058	0.0067	
12	State	0.0005	-0.0009	0.0019	0.4627	-0.0002			0.0071	0.0066	0.0076	
13	State	0.0029	0.0016	0.0042	0.0000	-0.0014			0.0065	0.0061	0.0070	
14	State	0.0012	0.0001	0.0024	0.0401	-0.0006			0.0059	0.0055	0.0063	
15	State	0.0013	0.0000	0.0027	0.0447	-0.0007			0.0067	0.0062	0.0071	
16	State	0.0017	0.0004	0.0030	0.0109	-0.0008			0.0066	0.0061	0.0070	
17	State	0.0023	0.0011	0.0036	0.0004	-0.0011			0.0065	0.0060	0.0069	

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Blue shade means that identified significance exists not only in this 805 nm wavelength data but also in 830nm wavelength data, Red shade means that identified significance exists in all wavelength data. There is no random effect.

**Table S21.** Beta ~ State+(1|subject) , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	State	0.0051	0.0034	0.0069	0.0000	-0.0025			0.0088	0.0082	0.0094	
2	State	0.0041	0.0028	0.0054	0.0000	-0.0020			0.0066	0.0062	0.0071	
3	State	0.0032	0.0010	0.0053	0.0038	-0.0016			0.0108	0.0101	0.0116	
4	State	0.0052	0.0034	0.0069	0.0000	-0.0025			0.0088	0.0082	0.0094	
5	State	0.0040	0.0024	0.0056	0.0000	-0.0020			0.0080	0.0075	0.0086	
6	State	0.0037	0.0019	0.0055	0.0001	-0.0018			0.0091	0.0085	0.0098	
7	State	0.0019	0.0006	0.0032	0.0043	-0.0009			0.0066	0.0061	0.0070	

8	State	0.0016	0.0001	0.0031	0.0364	-0.0008		0.0076	0.0071	0.0082
9	State	0.0027	0.0012	0.0042	0.0004	-0.0013		0.0076	0.0071	0.0081
10	State	0.0028	0.0011	0.0044	0.0013	-0.0014		0.0085	0.0079	0.0091
11	State	0.0031	0.0018	0.0045	0.0000	-0.0015		0.0067	0.0063	0.0072
12	State	0.0008	-0.0007	0.0024	0.2671	-0.0004		0.0076	0.0071	0.0081
13	State	0.0032	0.0018	0.0046	0.0000	-0.0016		0.0071	0.0066	0.0076
14	State	0.0015	0.0002	0.0028	0.0227	-0.0007		0.0064	0.0060	0.0069
15	State	0.0016	0.0002	0.0030	0.0245	-0.0008		0.0071	0.0066	0.0076
16	State	0.0021	0.0007	0.0034	0.0033	-0.0010		0.0070	0.0065	0.0075
17	State	0.0025	0.0012	0.0039	0.0003	-0.0012		0.0070	0.0065	0.0075

SD: standard deviation, CI: confident interval, the state consists of the rest state and task state, The value of the rest state is 0, and the value of the task state is 1, df = 18 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 394, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength data, Blue shade means that identified significance exists not only in this 830 nm wavelength data but also in 805nm wavelength data, Red shade means that identified significance exists in all wavelength density data. There is no random effect.

**Table S22.** Beta~ Rest duration+ (1|subject) , 780 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	-0.1490	-0.3590	0.0611	0.1635	-0.0001			0.0077	0.0070	0.0085	
2	RD	-0.0895	-0.2517	0.0727	0.2781	0.0000			0.0060	0.0054	0.0066	
3	RD	-0.1029	-0.4290	0.2232	0.5344	0.0007			0.0120	0.0109	0.0133	
4	RD	-0.0823	-0.2824	0.1178	0.4184	-0.0007			0.0074	0.0067	0.0081	
5	RD	-0.1165	-0.3056	0.0726	0.2257	0.0005			0.0070	0.0063	0.0077	
6	RD	-0.1702	-0.4536	0.1133	0.2378	0.0015			0.0104	0.0095	0.0115	
7	RD	-0.0655	-0.2265	0.0955	0.4233	0.0001			0.0059	0.0054	0.0065	
8	RD	-0.1453	-0.3248	0.0342	0.1119	0.0013			0.0066	0.0060	0.0073	
9	RD	-0.1662	-0.3503	0.0178	0.0765	0.0014			0.0068	0.0061	0.0075	
10	RD	-0.1420	-0.3795	0.0954	0.2395	0.0004			0.0087	0.0079	0.0097	
11	RD	-0.0971	-0.2559	0.0617	0.2294	0.0000			0.0059	0.0053	0.0065	
12	RD	-0.1205	-0.2947	0.0538	0.1743	0.0014			0.0064	0.0058	0.0071	
13	RD	-0.1271	-0.2913	0.0371	0.1285	0.0006			0.0061	0.0055	0.0067	
14	RD	-0.0621	-0.2204	0.0961	0.4396	0.0001			0.0058	0.0053	0.0064	
15	RD	-0.0795	-0.2474	0.0885	0.3518	0.0005			0.0062	0.0056	0.0068	
16	RD	-0.0446	-0.2065	0.1172	0.5872	0.0002			0.0060	0.0054	0.0066	
17	RD	-0.0455	-0.2059	0.1148	0.5759	0.0000			0.0059	0.0054	0.0065	

RD: rest duration, \* :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Beta value calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, There is no random effect.

**Table S23.** Beta~ Rest duration+ (1|subject) , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size*	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower*	Upper*				Lower	Upper		Lower	Upper
1	RD	-0.1105	-0.3339	0.1129	0.3304	-0.0012			0.0082	0.0075	0.0091	
2	RD	-0.0761	-0.2408	0.0886	0.3633	-0.0010			0.0061	0.0055	0.0067	
3	RD	-0.1089	-0.4365	0.2188	0.5131	-0.0003			0.0121	0.0109	0.0133	
4	RD	-0.0563	-0.2771	0.1645	0.6155	-0.0018			0.0081	0.0074	0.0090	
5	RD	-0.1033	-0.3085	0.1019	0.3221	-0.0006			0.0076	0.0069	0.0083	
6	RD	-0.1702	-0.4353	0.0949	0.2070	0.0000			0.0098	0.0089	0.0108	
7	RD	-0.0678	-0.2390	0.1034	0.4356	-0.0001			0.0063	0.0057	0.0070	
8	RD	-0.1285	-0.3231	0.0662	0.1946	0.0006			0.0072	0.0065	0.0079	
9	RD	-0.1379	-0.3340	0.0582	0.1672	0.0002			0.0072	0.0065	0.0080	
10	RD	-0.1202	-0.3661	0.1257	0.3362	0.0000			0.0091	0.0082	0.0100	
11	RD	-0.0913	-0.2637	0.0811	0.2977	-0.0005			0.0064	0.0058	0.0070	
12	RD	-0.1079	-0.3042	0.0883	0.2794	0.0007			0.0072	0.0066	0.0080	
13	RD	-0.1068	-0.2873	0.0737	0.2449	-0.0005			0.0067	0.0060	0.0073	
14	RD	-0.0626	-0.2308	0.1055	0.4635	0.0000			0.0062	0.0056	0.0068	
15	RD	-0.0506	-0.2396	0.1383	0.5978	-0.0002			0.0070	0.0063	0.0077	
16	RD	-0.0248	-0.2068	0.1572	0.7886	-0.0006			0.0067	0.0061	0.0074	
17	RD	-0.0592	-0.2371	0.1187	0.5123	-0.0006			0.0066	0.0059	0.0072	

RD: rest duration, \* :  $\times 10^{-3}$ , SD: standard deviation, CI: confident interval, Beta value calculated from the rest state only, df = 9 (the number of period) \*22 (the number of participant) -2 (the number of estimated variable) = 196, Significance is identified by CI not including 0 and p-value < 0.05, There is no random effect.



14	NF	0.0007	0.0003	0.0012	0.0010	-0.0013				0.0050	0.0045	0.0055
	DR	-0.0004	-0.0022	0.0013	0.6119							
	TD	0.0000	-0.0001	0.0001	0.9852							
15	NF	0.0010	0.0005	0.0015	0.0001	-0.0033				0.0056	0.0051	0.0062
	DR	0.0005	-0.0014	0.0024	0.6139							
	TD	0.0000	-0.0001	0.0002	0.9232							
16	NF	0.0013	0.0009	0.0018	0.0000	-0.0047				0.0051	0.0046	0.0056
	DR	0.0014	-0.0004	0.0031	0.1247							
	TD	0.0000	-0.0002	0.0001	0.5871							
17	NF	0.0011	0.0007	0.0015	0.0000	-0.0036	0.0021	0.0013	0.0033	0.0047	0.0042	0.0052
	DR	0.0010	-0.0006	0.0026	0.2164							
	TD	0.0000	-0.0002	0.0001	0.6128							

NF: natural frequency, DR: damping ratio, TD: task duration, SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 780 nm optical density data, Blue shade means that identified significance exists not only in this 780 nm wavelength data but also in 805 or 830nm wavelength data, Red shade means that identified significance exists in all wavelength data. Blank in random effect column means there is no random effect.

**Table S26.** Beta ~ Task duration+ $\omega_n + \zeta + (1 | \text{subject})$ , 805 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect				Error			
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)			
			Lower	Upper				Lower	Upper		Lower	Upper		
1	NF	0.0010	0.0003	0.0016	0.0036	0.0006					0.0075	0.0068	0.0082	
	DR	-0.0011	-0.0036	0.0015	0.4125									
	TD	0.0000	-0.0002	0.0002	0.7918									
2	NF	0.0009	0.0004	0.0014	0.0005	0.0010					0.0059	0.0053	0.0065	
	DR	-0.0015	-0.0036	0.0005	0.1328									
	TD	0.0000	-0.0002	0.0001	0.5714									
3	NF	0.0008	0.0001	0.0015	0.0225	0.0015	0.0042	0.0028	0.0064		0.0078	0.0070	0.0087	
	DR	-0.0024	-0.0051	0.0003	0.0815									
	TD	0.0000	-0.0002	0.0002	0.8098									
4	NF	0.0009	0.0003	0.0016	0.0036	0.0019					0.0073	0.0066	0.0080	
	DR	-0.0016	-0.0041	0.0009	0.2145									
	TD	-0.0001	-0.0003	0.0001	0.4129									
5	NF	0.0013	0.0007	0.0019	0.0001	-0.0013					0.0073	0.0066	0.0080	
	DR	-0.0008	-0.0033	0.0017	0.5451									
	TD	0.0000	-0.0002	0.0002	0.8250									
6	NF	0.0008	0.0002	0.0014	0.0082	0.0001	0.0033	0.0022	0.0052		0.0069	0.0062	0.0076	
	DR	-0.0014	-0.0038	0.0009	0.2353									
	TD	0.0000	-0.0001	0.0002	0.6442									
7	NF	0.0008	0.0004	0.0013	0.0001	-0.0004	0.0025	0.0017	0.0038		0.0048	0.0044	0.0054	
	DR	-0.0011	-0.0028	0.0005	0.1753									
	TD	0.0000	-0.0001	0.0001	0.8253									
8	NF	0.0013	0.0007	0.0019	0.0000	-0.0025					0.0068	0.0062	0.0075	
	DR	-0.0009	-0.0033	0.0014	0.4307									
	TD	0.0000	-0.0002	0.0002	0.7577									
9	NF	0.0012	0.0007	0.0017	0.0000	-0.0035	0.0027	0.0017	0.0042		0.0057	0.0051	0.0063	
	DR	0.0006	-0.0013	0.0026	0.5287									
	TD	0.0000	-0.0001	0.0002	0.6491									
10	NF	0.0010	0.0004	0.0016	0.0006	-0.0010					0.0066	0.0059	0.0072	
	DR	-0.0010	-0.0033	0.0012	0.3720									
	TD	0.0000	-0.0002	0.0002	0.8883									
11	NF	0.0010	0.0005	0.0015	0.0001	-0.0020					0.0059	0.0053	0.0065	
	DR	0.0005	-0.0015	0.0025	0.6241									
	TD	0.0000	-0.0002	0.0001	0.8297									
12	NF	0.0015	0.0009	0.0020	0.0000	-0.0046	0.0027	0.0017	0.0043		0.0059	0.0054	0.0066	
	DR	0.0005	-0.0016	0.0025	0.6608									
	TD	0.0000	-0.0002	0.0002	0.8995									
13	NF	0.0014	0.0009	0.0019	0.0000	-0.0028					0.0060	0.0054	0.0066	
	DR	0.0004	-0.0017	0.0024	0.7303									
	TD	0.0000	-0.0002	0.0001	0.7550									
14	NF	0.0008	0.0003	0.0013	0.0011	-0.0008					0.0055	0.0049	0.0060	
	DR	-0.0008	-0.0027	0.0011	0.3882									
	TD	0.0000	-0.0002	0.0001	0.8353									
15	NF	0.0013	0.0007	0.0018	0.0000	-0.0028					0.0060	0.0054	0.0066	
	DR	0.0002	-0.0019	0.0022	0.8840									
	TD	-0.0001	-0.0002	0.0001	0.5485									
16	NF	0.0016	0.0011	0.0021	0.0000	-0.0042					0.0059	0.0053	0.0065	
	DR	0.0012	-0.0009	0.0032	0.2581									
	TD	-0.0001	-0.0003	0.0001	0.2491									
17	NF	0.0014	0.0009	0.0019	0.0000	-0.0033					0.0060	0.0054	0.0066	
	DR	0.0008	-0.0012	0.0029	0.4170									
	TD	-0.0001	-0.0002	0.0001	0.4527									

NF: natural frequency, DR: damping ratio, TD: task duration, SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the

number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 805 nm wavelength data, Blue shade means that identified significance exists not only in this 805 nm wavelength data but also in 830nm wavelength data, Red shade means that identified significance exists in all wavelength data. Blank in random effect column means there is no random effect.

**Table S27.** Beta ~ Task duration+ $\omega_n + \zeta + (1|\text{subject})$ , 830 nm optical density data statistical results.

CH	Parameter	Fixed effect				Estimated intercept	Random effect			Error		
		Effect size	CI(95%)		p-value		SD	CI(95%)		SD	CI(95%)	
			Lower	Upper				Lower	Upper		Lower	Upper
1	NF	0.0011	0.0004	0.0018	0.0027	0.0009				0.0083	0.0075	0.0092
	DR	-0.0012	-0.0040	0.0017	0.4185							
	TD	0.0000	-0.0003	0.0002	0.6725							
2	NF	0.0011	0.0006	0.0017	0.0001	0.0007				0.0064	0.0058	0.0070
	DR	-0.0014	-0.0036	0.0007	0.1934							
	TD	-0.0001	-0.0002	0.0001	0.5622							
3	NF	0.0009	0.0002	0.0016	0.0131	0.0017	0.0041	0.0027	0.0063	0.0081	0.0073	0.0090
	DR	-0.0025	-0.0053	0.0003	0.0765							
	TD	0.0000	-0.0003	0.0002	0.7703							
4	NF	0.0010	0.0003	0.0017	0.0053	0.0025				0.0082	0.0075	0.0091
	DR	-0.0019	-0.0048	0.0009	0.1812							
	TD	-0.0001	-0.0003	0.0001	0.3859							
5	NF	0.0015	0.0008	0.0022	0.0000	-0.0007				0.0077	0.0070	0.0085
	DR	-0.0012	-0.0039	0.0014	0.3654							
	TD	0.0000	-0.0003	0.0002	0.6711							
6	NF	0.0010	0.0004	0.0016	0.0024	0.0003	0.0033	0.0021	0.0052	0.0072	0.0065	0.0080
	DR	-0.0016	-0.0040	0.0009	0.2112							
	TD	0.0000	-0.0002	0.0002	0.8439							
7	NF	0.0009	0.0005	0.0014	0.0001	0.0000	0.0026	0.0017	0.0040	0.0054	0.0049	0.0060
	DR	-0.0016	-0.0034	0.0003	0.0989							
	TD	0.0000	-0.0002	0.0001	0.6286							
8	NF	0.0014	0.0007	0.0020	0.0000	-0.0022				0.0073	0.0066	0.0081
	DR	-0.0011	-0.0036	0.0014	0.3748							
	TD	0.0000	-0.0002	0.0002	0.9367							
9	NF	0.0013	0.0008	0.0019	0.0000	-0.0033	0.0028	0.0018	0.0045	0.0063	0.0057	0.0070
	DR	0.0006	-0.0016	0.0027	0.6092							
	TD	0.0000	-0.0002	0.0002	0.8724							
10	NF	0.0012	0.0006	0.0018	0.0002	-0.0007				0.0072	0.0065	0.0080
	DR	-0.0014	-0.0039	0.0011	0.2608							
	TD	0.0000	-0.0002	0.0002	0.9089							
11	NF	0.0011	0.0005	0.0016	0.0001	-0.0017				0.0063	0.0057	0.0070
	DR	0.0004	-0.0018	0.0025	0.7447							
	TD	0.0000	-0.0002	0.0001	0.7153							
12	NF	0.0016	0.0010	0.0021	0.0000	-0.0046	0.0029	0.0018	0.0046	0.0064	0.0058	0.0071
	DR	0.0004	-0.0017	0.0026	0.6864							
	TD	0.0000	-0.0002	0.0002	0.8788							
13	NF	0.0015	0.0009	0.0020	0.0000	-0.0025				0.0066	0.0060	0.0073
	DR	0.0002	-0.0021	0.0025	0.8605							
	TD	0.0000	-0.0002	0.0001	0.6013							
14	NF	0.0010	0.0005	0.0015	0.0003	-0.0006				0.0060	0.0054	0.0066
	DR	-0.0012	-0.0032	0.0009	0.2669							
	TD	0.0000	-0.0002	0.0001	0.6112							
15	NF	0.0014	0.0008	0.0019	0.0000	-0.0028				0.0064	0.0058	0.0071
	DR	0.0001	-0.0021	0.0023	0.9067							
	TD	-0.0001	-0.0002	0.0001	0.5328							
16	NF	0.0017	0.0012	0.0023	0.0000	-0.0040				0.0062	0.0057	0.0069
	DR	0.0010	-0.0012	0.0031	0.3692							
	TD	-0.0001	-0.0003	0.0001	0.2031							
17	NF	0.0015	0.0009	0.0021	0.0000	-0.0029				0.0066	0.0059	0.0072
	DR	0.0004	-0.0019	0.0026	0.7469							
	TD	-0.0001	-0.0003	0.0001	0.4383							

NF: natural frequency, DR: damping ratio, TD: task duration, SD: standard deviation, CI: confident interval, df = 9 (the number of period) \*22 (the number of participant) -4 (the number of estimated variable) = 194, Significance is identified by CI not including 0 and p-value < 0.05, Gray shade means that identified significance exists only in this 830 nm wavelength data. Blue shade means that identified significance exists not only in this 830 nm wavelength data but also in 805nm wavelength data, Red shade means that identified significance exists in all wavelength data.

**Table S28.** Mechanical impedance conditions.

		Damping ratio			
		$\zeta$	0.5	1	1.5
Natural frequency	$\omega_n$				
	1	#1	#2	#3	
	3	#4	#5	#6	
	5	#6	#7	#9	

**Table S29.** Mechanical impedance condition orders of participants.

Participant	Mechanical impedance condition order								
kmj(M)	3	8	7	2	1	6	5	9	4
wjh(F)	3	1	5	2	7	9	8	4	6
ksj_1(M)	1	9	8	3	5	4	7	6	2
kjs(M)	2	9	5	8	4	3	6	1	7
lcj(M)	1	3	7	4	6	8	2	9	5
cgy(F)	6	8	4	7	5	2	3	9	1
cpj(M)	6	3	1	5	9	4	8	7	2
lkj(F)	2	8	1	6	3	9	5	7	4
lje(F)	5	2	4	7	3	9	8	6	1
jnc(M)	3	1	6	7	2	4	9	5	8
sjh(M)	4	1	3	5	2	8	9	7	6
jsj(F)	6	7	3	1	2	5	9	4	8
hjl(M)	2	1	4	3	9	8	7	5	6
kjh(M)	6	8	1	5	9	3	2	4	7
cjh(M)	4	7	6	2	9	8	5	1	3
nse(M)	5	2	9	4	8	1	6	7	3
sey(F)	7	2	9	5	3	1	6	8	4
kjc(M)	1	6	5	3	4	8	9	2	7
hmc(M)	6	5	3	1	7	8	9	4	2
ksj_2(M)	2	9	3	5	1	8	7	6	4
ces(F)	3	9	4	7	2	5	1	8	6
sah(F)	7	6	2	3	1	9	4	5	8

M: male, F: female, ksj\_1 and ksj\_2 are different participants. Mechanical impedance conditions were conducted at the task period.



**Table S30.** Summary of results of the previous study.

<div>Neuron group</div> <div>Motion</div>	Group A	Group B
Elbow extension torque	Discharge rate decreases. (Case 1.)	Discharge rate increases. (Case 2.)
Elbow flexion torque	Discharge rate increases. (Case 3.)	Discharge rate decreases. (Case 4.)