Multimedia Appendix 1. Supplementary Materials

Tables

The results in these tables relate to the main HMM reported in the manuscript, i.e. the two-state model trained on withheld healthy controls with high data availability and assessed on the validation set. For additional tables of results from alternative HMM variations (i.e. different number of hidden states, trained on whole dataset) see Multimedia Appendix 2.

Table S1: Demographics of healthy controls with training/validation split.

Set	Number	Age	Gender	Dataset	Country	Education years
		(Mean (SD))				(Mean (SD))
Training	91	60 (14)	F=47;	PRISM=16;	NL=83;	7 (5)
			M=44	HO=75	ES=8	
Validation	156	58 (12)	F=93;	PRISM=12;	NL=151;	6 (3)
			M=63	HO=144	ES=5	

*SD: standard deviation; F: female, M: male; NL: the Netherlands, ES: Spain.

Table S2: Results from linear regression models predicting SFS score from total dwell time and age, with separate models run for the different groups.

Group	Predictor	Coefficient	Standard	<i>t</i> value	P value	FDR corrected
			error			P value
Healthy	Total	0.1153	0.0257	4.4784	.002	.005
controls	dwell time					
(n=12)	Age	0.0100	0.0357	0.2810	.79	1.0
Schizophrenia	Total	0.1657	0.1166	1.4211	.18	.53
(n=18)	dwell time					
	Age	0.1164	0.3188	0.3651	.72	1.0
Alzheimer's	Total	-0.1994	0.0752	-2.6501	.02	.052
disease (n=19)	dwell time					
	Age	0.0380	0.1696	0.2239	.83	1.0

Note that the significant result observed for healthy controls here was not observed when considering all healthy controls using the HMMs trained on all participants.

Table S3: Results from a linear regression model predicting Loneliness score from total dwell time, age and group where healthy controls (n=12) were the reference group.

Predictor	Coefficient	Standard error	<i>t</i> value	P value
Age	0.0052	0.0034	1.5480	.13
Group:	0.4452	0.2859	1.5573	.13
Schizophrenia				
(n=18)				
Group:	-0.2691	0.2096	-1.2841	.21
Alzheimer's				
disease (n=19)				
Total dwell time	-0.0016	0.0028	-0.5668	.57
Interaction:	-0.0004	0.0046	-0.0909	.93
Schizophrenia and				
total dwell time				
Interaction:	0.0031	0.0044	0.7200	.48
Alzheimer's				
disease and total				
dwell time				

The other HMMs provided comparable results.

Table S4: Results from the age predictor in the multinomial logistic regression model predicting diagnostic group (versus healthy controls (n=156)) from total dwell time and age.

Group	Coefficient	Standard	Odds ratio	z value	P value	FDR
		error	(95% CI)			corrected P
						value
Schizophrenia	-0.1660	0.0298	0.8470	-5.5737	<.001	<.001
(n=18)			(0.7886-			
			0.9054)			
Alzheimer's disease	0.0801	0.0295	1.0834	2.7158	.007	.02
(n=26)			(1.0256-			
			1.1411)			
Subjective cognitive	0.0125	0.0163	1.0126	0.7665	.44	1.0
complaints (n=57)			(0.9806-			
			1.0446)			

Table S5: Binomial logistic regression age sensitivity analysis results. A model was run per diagnostic group, where the reference group for each model was age-matched healthy controls. Age cut-offs for healthy controls (HC) matched to each diagnostic group (schizophrenia (SZ), Alzheimer's disease (AD), subjective cognitive complaints (SCC)): HC vs SZ, Age < 42 (HC n=12); HC vs AD, Age > 50 (HC n=130); HC vs SCC, Age > 43 (HC n=142).

Group	Predictor	Coefficient	Standard	Odds	z value	P value	FDR
			error				corrected
							P value
Schizophrenia	Total	-0.0036	0.0190	0.9964	-0.1882	.85	1.0
(n=18)	dwell						
	time						
	Age	0.0621	0.0633	1.0641	0.9810	.33	0.98
Alzheimer's	Total	-0.0521	0.0136	0.9493	-3.8421	<.001	<.001
disease (n=26)	dwell						
	time						
	Age	0.0527	0.0327	1.0541	1.6134	.11	.32
Subjective	Total	-0.0283	0.0086	0.9721	-3.2932	<.001	.003
cognitive	dwell						
complaints	time						
(n=57)	Age	-0.0199	0.0210	0.9803	-0.9436	.35	1.0

Table S6: Results from a linear regression model predicting MMSE score from total dwell time, age and group where healthy controls (n=12) were the reference group. P values were corrected considering four tests.

Predictor	Coefficient	Standard error	<i>t</i> value	<i>P</i> value	FDR corrected <i>P</i> value
Age	-0.0045	0.0222	-0.2025	.84	1.0
Total dwell time	0.0139	0.0177	0.7865	.44	1.0
Group: Alzheimer's disease (n=19)	-4.9630	1.2990	-3.8207	<.001	.003
Interaction: Alzheimer's disease and total dwell time	0.0083	0.0271	0.3074	.76	1.0

The other HMMs provided comparable results.

Table S7: Results from linear regression models predicting PANSS (sub)scores in participants with schizophrenia (n=18). PANSS_PT: Positive Scale, PANSS_NT: Negative Scale, PANSS_GT: General Psychopathology Scale, PANSS_CS: Composite Scale.

Response	Predictor	Coefficient	Standard error	t value	P value
PANSS_PT	Total dwell time	-0.0227	0.0543	-0.4184	.68
	Age	-0.0015	0.1484	-0.0098	.99
PANSS_NT	Total dwell time	0.0018	0.0999	0.0176	.99
	Age	-0.0876	0.2731	-0.3208	.75
PANSS_GT	Total dwell time	0.0688	0.0954	0.7205	.48
	Age	0.1898	0.2610	0.7273	.48
PANSS_CS	Total dwell time	-0.0245	0.0812	-0.3013	.77
	Age	0.0861	0.2220	0.3880	.70
PANSS_TOTAL	Total dwell time	0.0478	0.2196	0.2178	.83
	Age	0.1008	0.6005	0.1678	.87

The other HMMs provided comparable results.



Figure S1: Distributions of hourly percentage values per channel for all time series. It can be seen that these distributions are very zero-inflated. (A) Outgoing call, (B) incoming call, (C) social media app, (D) communication app, (E) overall phone usage.



Figure S2: Percentage of overall data availability for all participants, split by set. These values indicate missingness. (A) Training participants, (B) validation participants.



Figure S3: Percentage of overall data availability for validation participants, split by diagnostic group. These values indicate missingness. (A) Healthy controls, (B) participants with schizophrenia, (C) participants with Alzheimer's disease, (D) subjective cognitive complaints participants.



Figure S4: Percentage of GPS data availability for all participants, split by set. These values indicate missing GPS data. (A) Training participants, (B) validation participants.



Figure S5: Percentage of GPS data availability for validation participants, split by diagnostic group. These values indicate missing GPS data. (A) Healthy controls, (B) participants with schizophrenia, (C) participants with Alzheimer's disease, (D) subjective cognitive complaints participants.



Figure S6: Days of data for all participants, split by set. These values show the time series length. (A) Training participants, (B) validation participants.



Figure S7: Days of data for validation participants, split by diagnostic group. These values show the time series length. (A) Healthy controls, (B) participants with schizophrenia, (C) participants with Alzheimer's disease, (D) subjective cognitive complaints participants.



Figure S8: Age distributions of all participants, split by set. (A) Training participants, (B) validation participants.



Figure S9: Social Functioning Scale scores of all available participants, split by set. (A) Training participants, (B) validation participants. Possible range in scores: 55-135.



Figure S10: Social Functioning Scale scores of available validation participants, split by diagnostic group. (A) Healthy controls, (B) participants with schizophrenia, (C) participants with Alzheimer's disease.



Figure S11: Loneliness scores of all available participants, split by set. (A) Training participants, (B) validation participants. Possible range in scores: 0-11.



Figure S12: Loneliness scores of available validation participants, split by diagnostic group. (A) Healthy controls, (B) participants with schizophrenia, (C) participants with Alzheimer's disease.



Figure S13: Mini-Mental State Examination scores of all available participants, split by set. (A) Training participants, (B) validation participants. Maximum score = 30.



Figure S14: Mini-Mental State Examination scores of available validation participants, split by diagnostic group. (A) Healthy controls, (B) participants with Alzheimer's disease.



Figure S15: Positive and Negative Syndrome Scale scores of participants with schizophrenia, split by (sub)scale. (A) Positive symptom scores (PT), (B) negative symptom scores (NT), (C) general psychopathology scores (GT), (D) composite scale scores (CS). Positive and Negative Scales range: 7-49; General Psychopathology Scale range: 16-112; Total PANSS score: sum of the sub scales; Composite Scale range: -42 to +42 (subtract negative score from positive score).