Electronic Supplementary materials
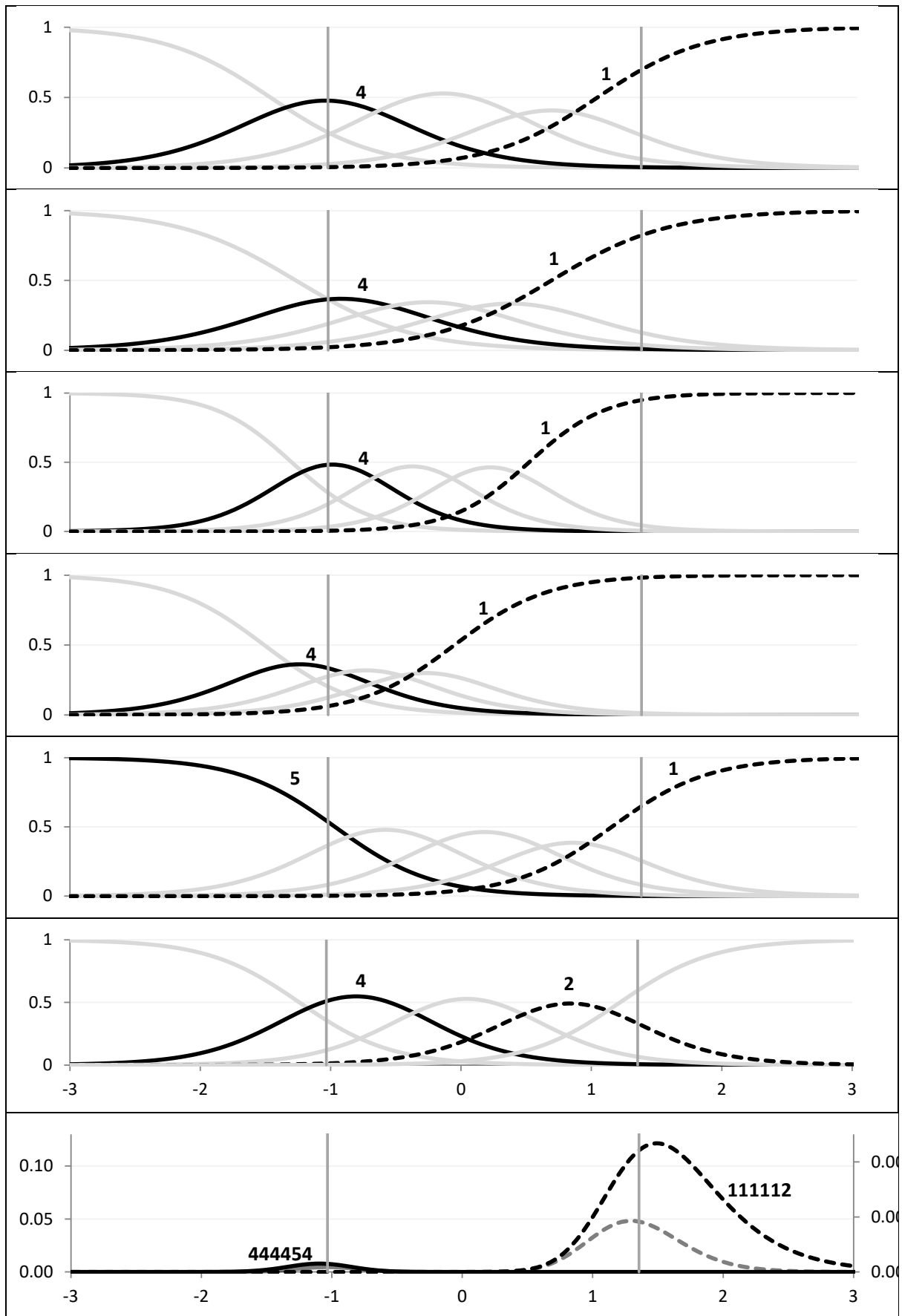
Appendix 1 ReQoL items

ReQoL-20 items

|		Response options
1.	I found it difficult to get started with everyday tasks *	5 frequency-based options ranging from: none of the time, only occasionally, sometimes, often, most or all of the time.
2.	I felt able to trust others *	
3.	I felt unable to cope *	
4.	I could do the things I wanted to do *	
5.	I felt happy *	
6.	I thought my life was not worth living *	
7.	I enjoyed what I did *	
8.	I felt hopeful about my future *	
9.	I felt lonely *	
10.	I felt confident in myself *	
11.	I did things I found rewarding	
12.	I avoided things I needed to do	
13.	I felt irritated	
14.	I felt like a failure	
15.	I felt in control of my life	
16.	I felt terrified	
17.	I felt anxious	
18.	I had problems with my sleep	
19.	I felt calm	
20.	I found it hard to concentrate	
Physical health question	Please describe your physical health (problems with pain, mobility, difficulties caring for yourself or feeling physically unwell) over the last week	5 severity-based options ranging from: no problems, slight problems, moderate problems, severe problems and very severe problems.

*ReQoL -10 consists of the first ten items and ReQoL-20 is made up of the 20 items. Both versions contain the last physical item which is not included in the summative score.
Further details, sample copies, scoring guides and requests for permissions to use the ReQoL measures are available from: The Clinical Outcomes team at Oxford University Innovation Ltd at: http://innovation.ox.ac.uk/outcome-measures/recovering-quality-life-reqol-questionnaire/
ReQoL™ (10 and 20) – © Copyright, University of Sheffield 2016 2018. All Rights Reserved.

Appendix Figure A1

Appendix Figure 1 illustrates the calculation of the probability of different response combinations for different levels of health. Each of the first six panels illustrates the IRT model for each of the six chosen ReQoL items used for valuation. Item response values are coded so a high response indicates poor mental health. The response combination 444454 provides an estimated theta value of -1.03. The probability of each item response can be seen in the first six panels. The probability of the combined response (0.001) is seen in the lowest panel (black line). This probability is compared with the probability of other response combinations providing a theta estimate in the same range. The response combination 111112 provides an estimated theta value of 1.36. The probability of the combined response (0.017) seen in the lowest panel is compared with the probability of other response combinations providing a theta estimate in this range. The grey lines in the lower panel show the probability of each response combination weighted by a prior assumption about the theta distribution. This function is used for score estimation by the expected *a posteriori* (EAP) approach.

Appendix Figure 2 Histogram of observed TTO values for ReQoL-UI

Observed TTO distribution
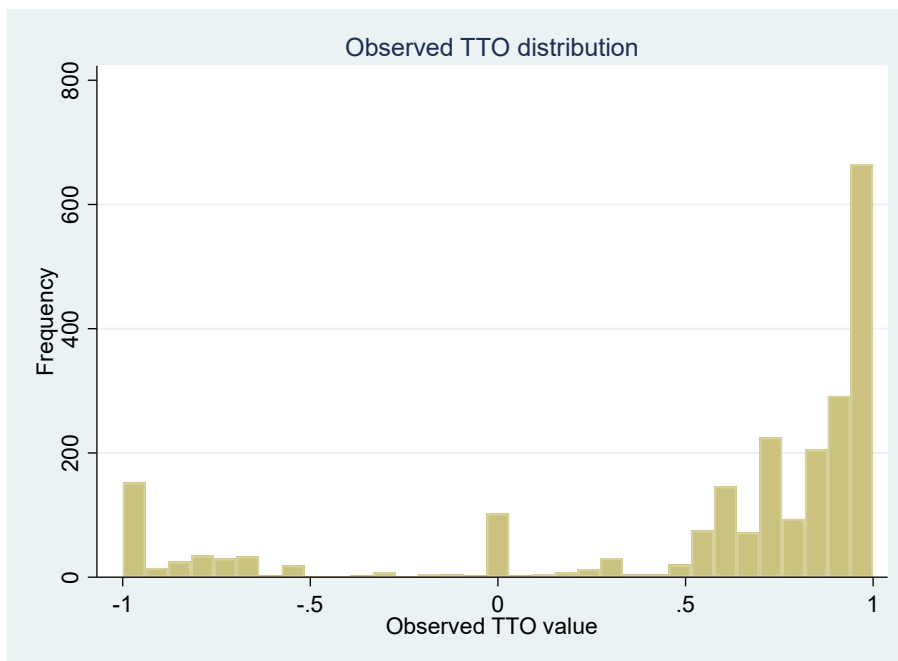
Appendix Figure 3 Plot of predicted versus observed utility values for the best mean OLS model (Model
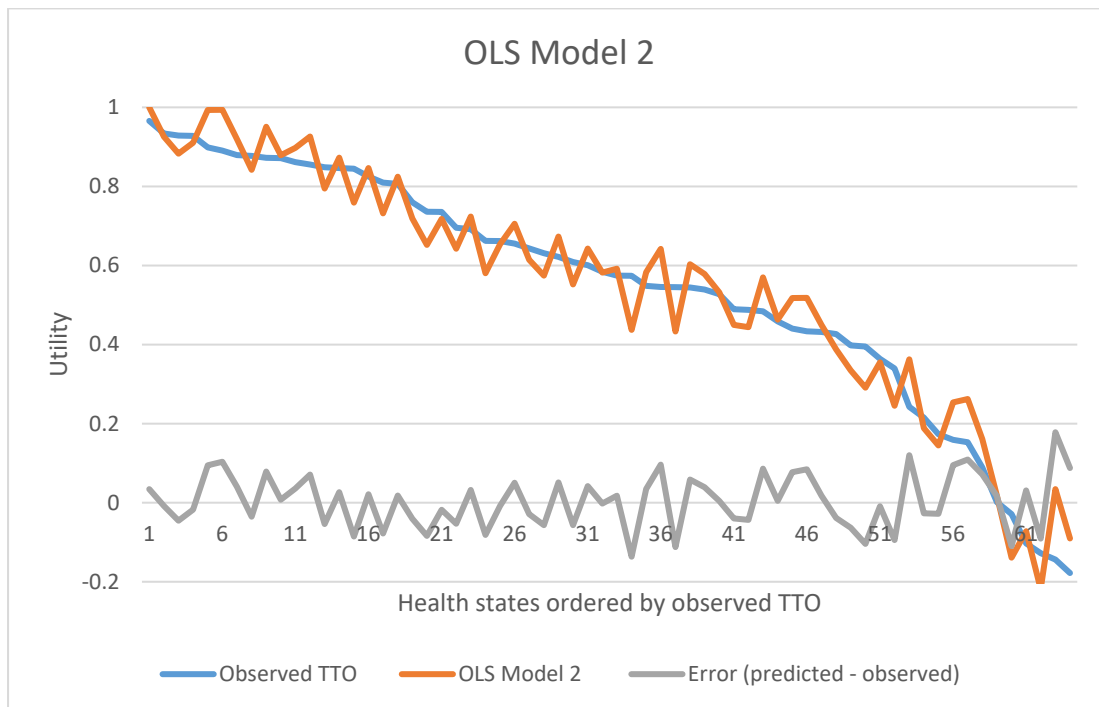
Appendix Table 1 Time Trade Off (TTO) Values by Health States from the Valuation Survey

Health states[a]	N	Mean TTO	SD	Min	Maximum	25% percentile	Median	75% percentile
1111111	38	0.966	0.063	0.725	1	0.950	1	1
1111113 [b]	36	0.855	0.364	-1	1	0.888	0.950	1
1111115 [b]	36	0.655	0.487	-0.825	1	0.625	0.825	0.925
1111125	42	0.662	0.544	-1	1	0.700	0.888	0.981
1111211	34	0.899	0.245	0	1	0.925	0.978	1
1111224	41	0.546	0.644	-1	1	0.525	0.825	1
1111322	31	0.879	0.310	-0.725	1	0.900	1	1
2111111	42	0.890	0.226	0	1	0.925	0.958	1
2111124	35	0.601	0.510	-1	1	0.525	0.750	0.925
2111212	37	0.934	0.1871	0	1	0.925	1	1
2111225	40	0.574	0.607	-1	1	0.613	0.813	0.938
2111322	34	0.928	0.083	0.675	1	0.925	0.938	1
2111334	41	0.631	0.529	-1	1	0.625	0.825	0.981
2121333	32	0.877	0.190	0	1	0.825	0.925	1
2211321	38	0.872	0.346	-0.925	1	0.925	1	1
3111324	43	0.662	0.551	-1	1	0.675	0.875	1
3111334	30	0.609	0.494	-1	1	0.625	0.725	1
3121332	40	0.846	0.308	-0.725	1	0.838	0.938	1
3221335	30	0.458	0.641	-1	1	0.225	0.7	1
3231335	43	0.545	0.607	-1	1	0.525	0.725	0.925
3231434	35	0.489	0.587	-1	1	0.300	0.725	0.875
3321331	41	0.862	0.319	-0.925	1	0.925	0.950	1
3321431	31	0.928	0.108	0.575	1	0.900	0.971	1
3331331	33	0.872	0.146	0.475	1	0.800	0.925	0.985
3331342	37	0.806	0.429	-1	1	0.825	0.925	1
3331435	28	0.427	0.630	-1	1	0.125	0.713	0.813
3331445	34	0.364	0.637	-1	1	0	0.625	0.825
3332431	41	0.825	0.350	-0.825	1	0.850	0.925	1
3332442	36	0.849	0.326	-0.975	1	0.838	0.925	1
3333333 [b]	40	0.845	0.183	0	1	0.738	0.900	0.983
3333443	36	0.760	0.354	-0.975	1	0.725	0.825	0.963
3432444	37	0.243	0.747	-1	1	-0.650	0.625	0.750
3433445	36	0.395	0.658	-1	1	0.188	0.650	0.825
3443445	34	0.159	0.729	-1	1	-0.700	0.450	0.775
4333444	40	0.398	0.649	-1	1	0.113	0.625	0.825
4343445	38	0.339	0.638	-1	1	0	0.625	0.775
4433445	35	0.153	0.750	-1	1	-0.775	0.575	0.725
4443442	34	0.810	0.320	-0.7	1	0.750	0.913	1
4443545	39	0.215	0.701	-1	1	-0.375	0.550	0.725

Health states[a]	N	Mean TTO	SD	Min	Maximum	25% percentile	Median	75% percentile
4444443	34	0.696	0.520	-1	1	0.725	0.888	1
4444543	35	0.644	0.543	-1	1	0.638	0.800	0.965
4444553	39	0.584	0.542	-1	1	0.625	0.725	0.875
4454543	41	0.539	0.576	-1	1	0.525	0.725	0.925
4455552	34	0.549	0.640	-1	1	0.575	0.800	0.950
4543442	30	0.736	0.442	-0.825	1	0.725	0.825	1
4543545	38	0.089	0.729	-1	1	-0.675	0.300	0.700
4544441	33	0.692	0.514	-1	1	0.725	0.925	0.950
4544542	27	0.622	0.529	-1	1	0.625	0.800	0.950
4544554	37	0.173	0.725	-1	1	-0.675	0.575	0.675
4545553	28	0.440	0.694	-1	1	0.400	0.750	0.825
4554541	35	0.736	0.498	-1	1	0.775	0.925	0.954
4554551	44	0.544	0.667	-1	1	0.613	0.825	0.938
4555552	39	0.528	0.551	-1	1	0.525	0.725	0.825
5355553	28	0.488	0.648	-1	1	0.312	0.725	0.938
5455555	34	-0.178	0.781	-1	1	**-1**	-0.425	0.625
5544553	33	0.433	0.657	-1	1	0.275	0.725	0.875
5545551	43	0.484	0.657	-1	1	0.075	0.725	0.950
5553554	33	-0.144	0.783	-1	1	-1	-0.275	0.650
5554545	34	0.002	0.761	-1	1	-0.725	0	0.675
5554555	32	-0.103	0.728	-1	1	-0.813	0	0.638
5555543	39	0.432	0.660	-1	1	0.525	0.650	0.925
5555551 [b]	34	0.574	0.632	-1	1	0.675	0.825	0.950
5555554	37	-0.029	0.739	-1	1	-0.750	0	0.625
5555555 [b]	35	-0.128	0.727	-1	1	-0.775	0	0.625

[a] The health states are in the following order: activity (*act5p*); belonging (*bel2*); choice, control and autonomy (*cho4*); hope (hop4); self-perception (*sel2p*); well-being (*wb11p*) and physical health. [b] These health states were among the five selected purposively.

Appendix Table 2 Random effects linear models

RE models; Dependent variable : distto , independent variable newtheta

VARIABLES	Model1a_NC	Model1b_NC	Model1c_NC	Model1d_NC	Model1e_NC	Model1f_NC
θ (newtheta)	-0.619***	-0.593***	-0.602***	-0.441***	-0.455***	-0.472***
phy2	0.0783**			0.0889		
phy3	0.00232	-0.0262		0.0266	0.0181	-0.0712**
phy4	-0.335***	-0.357***	-0.349***	-0.141***	-0.148***	-0.148***
phy5	-0.398***	-0.424***	-0.416***	-0.201***	-0.205***	-0.208***
inter2				-0.151		
inter3				-0.165	-0.147	
inter4				-0.492***	-0.478***	-0.469***
inter5				-0.465***	-0.454***	-0.440***
Constant	1	1	1	1	1	1
Observations	2303	2303	2303	2303	2303	2303
RMSE	0.1143	0.1211	0.1207	0.0822	0.0828	0.0843
MAE	0.0945	0.1037	0.1034	0.0693	0.0712	0.0730
AIC	3486	3491	3490	3451	3449	3449
BIC	3527	3525	3518	3514	3500	3495
Number of health states with errors >0.1 (abs)	29	33	32	13	14	18
Percentage of health states with errors >0.1 (abs)	45%	52%	50%	20%	22%	28%
Number of health states with errors >0.05 (abs)	46	49	50	39	42	45
Percentage of health states with errors >0.05 (abs)	72%	77%	78%	61%	66%	70%
Min utility for the 64 states	-0.017	-0.016	-0.019	-0.108	-0.114	-0.12
Max utility for the 64 states	1.002	1	1	1.027	1.018	1

Appendix Table 3 Random Effect quadratic models

Dependent variable : distto , independent variable newtheta

VARIABLES	Quadratic models						
	Model2a	Model2b	Model2c	Model2d	Model2e	Model2f	Model2g
θ (newtheta)	0.0701	0.0612	0.0280	0.0278	0.0278	0.0148	
$\theta2$ (newthetasq)	-0.747***	-0.739***	-0.582***	-0.581***	-0.591***	-0.558***	-0.574***
phy2	-0.00599		-0.0330	-0.0321	-0.0306		
phy3	-0.0533*	-0.0508*	-0.0495	-0.0494	-0.0895***	-0.0762***	-0.0770***
phy4	-0.402***	-0.399***	-0.265***	-0.265***	-0.267***	-0.261***	-0.264***
phy5	-0.463***	-0.461***	-0.292***	-0.292***	-0.294***	-0.288***	-0.290***
inter2			0.00171				
inter3			-0.0668	-0.0671			
inter4			-0.310***	-0.310***	-0.302***	-0.292***	-0.288***
inter5			-0.350***	-0.351***	-0.341***	-0.330***	-0.329***
Constant	1	1		1	1	1	1
Observations	2303	2303	2303	2303	2303	2303	2303
RMSE	0.0834	0.0835	0.0688	0.0688	0.0687	0.0697	0.0700
MAE	0.0648	0.0649	0.0566	0.0566	0.0567	0.0574	0.0576
AIC	3443	3442	3430	3428	3427	3426	3424
BIC	3489	3482	3499	3492	3484	3477	3470
Number of health states with errors >0.1 (abs)	14	14	8	8	10	10	9
Percentage of health states with errors >0.1 (abs)	22%	22%	13%	13%	16%	16%	14%
Number of health states with errors >0.05 (abs)	32	33	29	29	30	32	32
Percentage of health states with errors >0.05 (abs)	50%	52%	45%	45%	47%	50%	50%
Min utility for the 64 states	-0.14	-0.139	-0.196	-0.195	-0.199	-0.191	-0.193
max utility for the 64 states	1	1	1	1	1	1	1

Appendix Table 4 Random Effect cubic models

Dependent variable : distto , independent variable newtheta

VARIABLES	Model3a	Model3b	Model3c	Model3d	Model3e	Model3f	Model3g
θ (newtheta)	0.399*	0.364	0.280	0.217	0.227	0.147	
θ2 (newthetasq)	-1.688***	-1.627***	-1.304*	-1.122*	-1.158*	-1.030	-0.647***
θ3 (newthetacube)	0.658	0.629	0.486	-0.374	0.392	0.329	0.0809
phy2	-0.0142		-0.0689	-0.0359	-0.0347		
phy3	-0.0514*	-0.0459	-0.0567	-0.0515	-0.0873***	-0.0729**	-0.0741***
phy4	-0.418***	-0.412***	-0.294***	-0.282***	-0.285***	-0.275***	-0.260***
phy5	-0.468***	-0.463***	-0.303***	-0.297***	-0.300***	-0.292***	-0.286***
inter2			0.0629				
inter3			-0.0455	-0.0602			
inter4			-0.272**	-0.293***	-0.285***	-0.276***	-0.293***
inter5			-0.330***	-0.344***	-0.335***	-0.324***	-0.331***
Constant	1	1	1	1	1	1	1
Observations	2303	2303	2303	2303	2303	2303	2303
RMSE	0.0824	0.0827	0.0686	0.0692	0.0690	0.0702	0.0693
MAE	0.0649	0.0650	0.0568	0.0576	0.0576	0.0584	0.0574
AIC	3443	3441	3431	3430	3428	3427	3425
BIC	3495	3487	3506	3499	3491	3484	3477
Number of health states with errors >0.1 (abs)	17	16	10	10	11	11	10
Percentage of health states with errors >0.1 (abs)	27%	25%	16%	16%	17%	17%	16%
Number of health states with errors >0.05 (abs)	36	33	29	30	31	32	33
Percentage of health states with errors >0.05 (abs)	56%	52%	45%	47%	48%	50%	52%
Min utility for the 64 states	-0.098	-0.097	-0.17	-0.172	-0.175	-0.17	-0.183
Max utility for the 64 states	1.025	1.021	1.016	1.011	1.011	1.004	1

Appendix Table 5 OLS models

VARIABLES	Model1	Model 1c	Model 2	Model 2c	Model2e	Model 2f	Model 3	Model 3a	Model 3b	Model 3c	Model 3d
θ (newtheta)	-0.579***	-0.433***	0.100	0.00978	-0.052932		0.383	0.251	0.122	0.025	-0.428*
θ2 (newthetasq)			-0.767***	-0.572***	-0.5165521***	-0.5795743***	-1.605**	-1.275*	-0.909	-0.753	0.339
θ3 (newthetacube)							0.594	0.474	0.249	0.171	-0.440
phy2	0.085**	0.059	-0.014	-0.0688			-0.022	-0.103	-0.038		
phy3	0.009	0.001	-0.062*	-0.0737	-0.0836655***	-0.0876205***	-0.062*	-0.083	-0.074	-0.067	-0.031
phy4	-0.323***	-0.140**	-0.415***	-0.284***	-0.2701098***	-0.2859731***	-0.430***	-0.312***	-0.291***	-0.276***	
phy5	-0.394***	-0.189***	-0.476***	-0.294***	-0.2839871***	-0.2955383***	-0.482***	-0.307***	-0.295***	-0.286***	-0.234***
inter2		-0.099		0.0655				0.123			
inter3		-0.135		-0.0365				-0.013	-0.040	-0.025	-0.089
inter4		-0.503***		-0.292***	-0.2931935***	-0.2741532***		-0.254**	-0.295***	-0.289***	-0.705***
inter5		-0.501***		-0.362***	-0.3559337***	-0.3447323***		-0.339***	-0.368***	-0.355***	-0.432***
Constant	1	1	1	1	1	1	1	1	1	1	1
Observations	64	64	64	64	64	64	64	64	64	64	64
Adjusted R-squared	0.955	0.974	0.974	0.982	0.982	0.982	0.974	0.982	0.982	0.982	0.974
RMSE	0.1103	0.0817	0.0833	0.0673	0.0685	0.0688	0.0821	0.0666	0.0673	0.0683	0.0813
MAE	0.0911	0.0690	0.0651	0.0561	0.0575	0.0575	0.0656	0.0559	0.0570	0.0579	0.0641
AIC	-91	-121	-125	-144	-147	-149	-124	-143	-144	-144	-124
BIC	-80	-102	-112	-122	-132	-136	-109	-119	-122	-124	-106
Number of observations with AE >0.1	26	15	13	9	8	8	16	10	10	11	14

Percentage of observations with AE >0.1	41%	23%	20%	14%	13%	13%	25%	16%	16%	17%	22%
Number of observations with AE >0.05	42	42	32	32	33	32	36	29	31	33	36
Percentage of observations with AE >0.06	66%	66%	50%	50%	52%	50%	56%	45%	48%	52%	56%
Min utility for the 64 states	0.027	-0.124	-0.143	-0.219	-0.209	-0.22	-0.111	-0.196	-0.202	-0.199	-0.235
Max utility for the 64 states	1.009	1.001	1.002	1	1	1	1.024	1.013	1.003	1	1

Appendix Table 6 Summary comparisons of the various models

	RE models	OLS mean model
Observations	2303	64
RMSE range	0.069 to 0.121	0.0666 to 0.1103
MAE range	0.057 to 0.104	0.0559 to 0.0911
Number of health states with errors >0.1 (abs) range	8 to 33	8 to 26
Number of health states with errors >0.05 (abs) range	29 to 50	29 to 42
Min utility range for the 64 states across all models	-0.199 to -0.016	-0.235 to 0.027
max utility range for the 64 states across all models	1 to 1.027	1 to 1.024
Best models	2d and 2g	2e and 2f
Other observations	Cubic terms - not significant	Cubic terms - not significant