SUPPLEMENTARY MATERIAL FOR

PREDICTION OF SHIFTWORKER ALERTNESS, SLEEP, AND CIRCADIAN PHASE USING A MODEL OF AROUSAL DYNAMICS CONSTRAINED BY SHIFT SCHEDULES AND LIGHT EXPOSURE

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Transition	Diary	Shift	Shift+Light	Shift +Commute	Shift+Commute +Light	Sleep	Sleep +Light
OO (n=50)	8.4 ± 1.8	8.4 ± 0.2	8.3 ± 0.4	8.3 ± 0.7	8.3 ± 0.8	7.8 ± 1.4	7.9 ± 1.5
OE (n=13)	9.0 ± 1.5	8.5 ± 0.3	8.5 ± 0.1	8.4 ± 0.6	8.5 ± 0.2	8.4 ± 1.3	8.5 ± 1.3
OD (n=6)	6.8 ± 1.5	7.7 ± 0.5	8.4 ± 0.1	6.8 ± 1.3	7.5 ± 1.0	6.7 ± 1.5	6.7 ± 1.5
ON (n=17)	9.4 ± 3.8	8.5 ± 0.2	8.5 ± 0.2	8.5 ± 0.2	8.5 ± 0.3	7.8 ± 1.4	7.8 ± 1.4
NN (n=46)	6.2 ± 1.8	8.4 ± 0.5	8.1 ± 0.6	8.1 ± 0.6	7.9 ± 0.7	6.3 ± 1.7	6.3 ± 1.6
NO (n=12)	4.3 ± 1.2	8.3 ± 0.2	7.9 ± 0.2	8.0 ± 0.4	7.5 ± 0.3	4.5 ± 1.4	4.5 ± 1.2
EO (n=5)	8.1 ± 1.1	8.7 ± 0.0	8.6 ± 0.0	8.9 ± 0.3	8.7 ± 0.2	7.8 ± 0.7	7.9 ± 0.7
EE (n=8)	7.6 ± 1.1	8.6 ± 0.0	8.6 ± 0.1	8.6 ± 0.1	8.6 ± 0.2	7.5 ± 1.2	7.5 ± 1.2
ED (n=25)	5.6 ± 1.0	7.0 ± 1.1	8.1 ± 0.6	5.7 ± 0.8	6.1 ± 0.9	5.5 ± 1.0	5.6 ± 1.0
DO (n=21)	8.2 ± 1.7	8.8 ± 0.9	8.5 ± 0.1	9.5 ± 1.6	8.8 ± 0.9	7.9 ± 1.2	7.9 ± 1.2
DE (n=12)	8.8 ± 1.3	8.9 ± 1.0	8.5 ± 0.1	9.1 ± 1.1	9.2 ± 1.1	8.5 ± 0.8	8.5 ± 0.8
DD (n=16)	6.7 ± 0.9	8.5 ± 0.2	8.4 ± 0.2	7.1 ± 1.3	8.1 ± 0.7	6.7 ± 0.8	6.7 ± 0.8
DN (n=2)	9.1 ± 1.6	8.6 ± 0.0	8.5 ± 0.1	9.8 ± 1.9	8.4 ± 0.1	7.4 ± 0.8	7.5 ± 0.8
EN (n=1)	8.1 ± 0.0	8.7 ± 0.0	8.6 ± 0.0	8.9 ± 0.0	8.8 ± 0.0	7.5 ± 0.0	7.6 ± 0.0
All (n=234)	7.6 ± 1.5	8.4 ± 0.5	8.4 ± 0.2	8.3 ± 1.1	8.2 ± 0.8	7.2 ± 1.1	7.2 ± 1.1

Table S1: Total-Sleep-Time [h] (mean $\pm$ std) in the study-data and the model. The first column indicates the time-period based on preceding and succeeding shifts. All 14 successive shift combination that occur in the study-data are presented in the rows with the number of appearances included in brackets. Note that scheduling rules at the hospital mean that night shifts are never followed by day or evening shifts, so, only 14 of the potential 16 transitions occur in the study data. Columns are included for the sleep diary data as well as the corresponding model predictions for six different evaluation constraints. Detail of the partitioning and definitions of shift type can be found in the *Methods* section of the paper. We performed statistical comparison between study data and model predictions using both a paired t-test and a Wilcoxon ranked-sum test, both at significance 0.05, for the null hypothesis that the model predictions and study data have the same mean and variance, and medians, respectively. Simulation entries are colored green to indicate that the null hypothesis could not be rejected (i.e., Model-predictions cannot be said to be significantly different to the study-data), red if the null hypothesis is rejected (model predictions can be said to be significantly different to the study-data), and yellow when the t-test and ranked-sum test give conflicting answers.

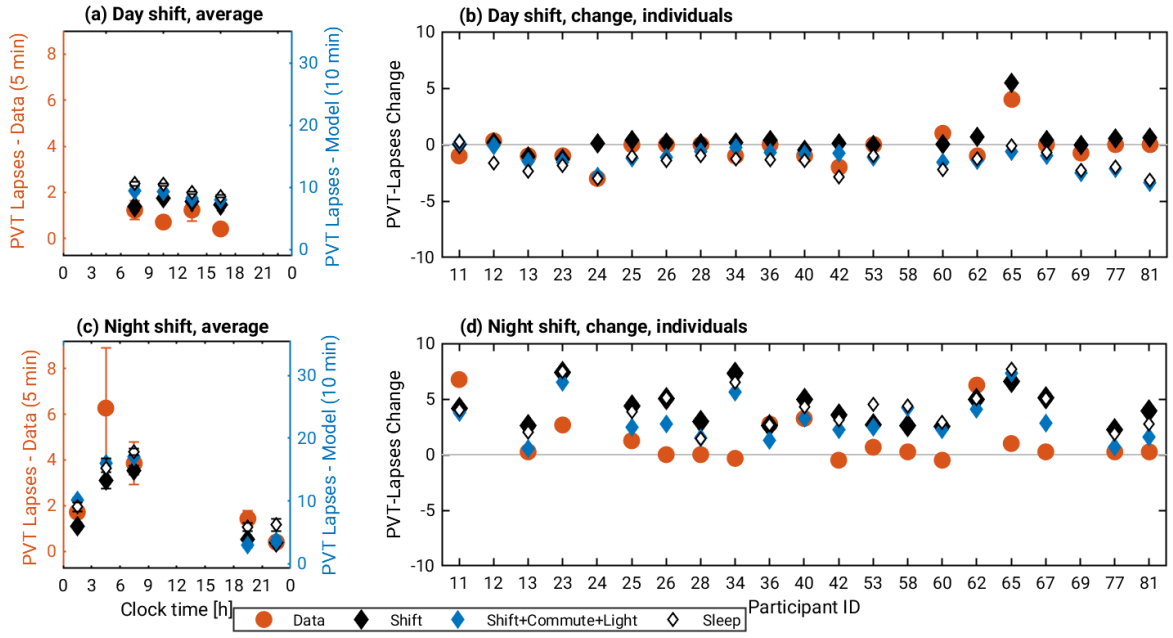

Figure S1. Comparison of study data and model predictions for objective performance measured with PVT lapses (PVT L). Model predictions for three evaluation constraints are shown: *Shift*, *Shift+Commute+Light* and *Sleep*. (a) Group average PVT L profile across all participants and data points on the day shift against clock time. (b) Individual predictions and study-data for PVT L change between the start and end of day shift ($PVTL_{end} - PVTL_{start}$). (c) Group average PVT L profile across all night shifts. (d) Predictions and study-data for PVT L change between the start and end of the night shift for each participant. In (a), (c) the PVT L values are binned in three-hour blocks and are plotted in the middle of each bin. Glyphs show mean values within each bin with bars indicating plus and minus the standard error in the mean. For (a),(c) the experimental data (Data) are plotted against the range on the left Y-axis, model predictions are shown against the range on the right Y-axis. The Y-axis scale is the same in (b) and (d).