Supplement 1: Annotated SAS-code for Model (1) and the different scenarios (Appendix B).

In the following, one can find the annotated SAS-code for Model (1), the scenarios described in the article and the model with group-specific components. We will use numbers between parentheses (e.g., (1)) in the SAS-code to annotate it. In this code, 'time' is a variable indicating the time passed since the start of the day (e.g., 7:30 a.m.) expressed in hours and 'passeddays' is the number of days passed since the start of the study. The SAS REPEATED statement requires an unique order of all observations within the blocks denoted by the SUBJECT-statement. The variables 'phd' and 'dayorder' indicate the order of all observations in this statement but have, beside their ordering role, no effect on the analysis (see the file with SAS-code provided as supplementary material for instructions how to obtain these variables). Note that, depending on the data at hand, serial autocorrelations for equally (e.g., AR(1)) or unequally spaced observations can be used and that many types of serial autocorrelation structures are available in SAS. An exemplary dataset and file with SAS-code is provided as supplementary material.

(a) Data: different measurements nested within signals nested within days nested within subjects (4-level model). This is Model (1).

```
PROC MIXED DATA=data;
CLASS id day signal phd diagnosis;
(1) MODEL affect = diagnosis /SOLUTION;
(2)(7)RANDOM intercept /SUBJECT=id TYPE=UN  GROUP=diagnosis;
(3)(7)RANDOM intercept /SUBJECT=day(id) TYPE=UN GROUP=diagnosis;
(4)(7)RANDOM intercept / SUBJECT=signal(day*id) TYPE=UN GROUP=diagnosis;
(5)(6)(7) REPEATED phd / SUBJECT=day(id) TYPE=SP(EXP or GAU) (time) LOCAL GROUP=diagnosis;
RUN;
```

Annotations:

-Fixed Effects

(1) Inclusion of fixed effects in the model (e.g., diagnosis, time, other covariates)

-Random Effects

(2) Subject-level: between-subject variance ($\sigma^2_{r_{000i}}$) SUBJECT=id implies that observations may be dependent within subjects; observations of different subjects are independent

(3) Day-level: long-term between-day variance ($\sigma^2_{r_{00di}}$) SUBJECT=day(id) implies that observations may be dependent within days (or day by subject combinations); observations of different days or subjects are independent

(4) Signal-level: short-term within-day variance ($\sigma^2_{r_{0sdi}}$). SUBJECT=signal(day*id) is used because SAS does not allow TYPE=signal(day(id)). Observations may be dependent within signals (or signal by day by subject combinations); observations of different signals or days or subjects are independent.

-Errors

(5) SUBJECT=day(id) TYPE=SP(EXP or GAU) (time): serial autocorrelation component ($\epsilon_{(1)msdi}$ with θ and τ^2)

SUBJECT=day(id) implies that observations may be dependent within days (or day by subject combination) with the (Exponential or Gaussian) serial autocorrelation being a function of the time interval between observations (time = passed hours since the start of the day). The serial correlation pertains to successive signals. Observations of different days and/or subjects are independent.

(6) The LOCAL option adds an observational error to a time series structure: Variance of measurement error ($\sigma^2_{\epsilon_{(2)msdi}}$)

(7) The GROUP-statement makes each of the involved variance or serial autocorrelation component group-specific. Model (1) is estimated using this SAS code without the GROUP statement.

(b) Data: different signals nested within days nested within subjects (3-level model).

```
PROC MIXED DATA=data;
CLASS id day signal phd diagnosis;
(1)MODEL affect = diagnosis /SOLUTION;
(2)RANDOM intercept /SUBJECT=id TYPE=UN ;
(3)RANDOM intercept /SUBJECT=day(id) TYPE=UN;
(5)(6) REPEATED phd / SUBJECT=day(id) TYPE=SP(EXP or GAU) (time) LOCAL;
RUN;
```

Annotations:

-Fixed Effects

(1) Inclusion of fixed effects in the model (e.g., diagnosis, time, other covariates)

-Random Effects

(2) Subject-level: between-subject variance ($\sigma^2_{r_{00i}}$) SUBJECT=id implies that observations may be dependent within subjects; observations of different subjects are independent

(3) Day-level: long-term between-day variance ($\sigma^2_{r_{0di}}$) SUBJECT=day(id) implies that observations may be dependent within days (or day by subject combinations); observations of different days or subjects are independent

-Errors

(5) SUBJECT=day(id) TYPE=SP(EXP or GAU) (time): serial autocorrelation component ($\epsilon_{(1)sdi}$ with θ and τ^2) SUBJECT=day(id) implies that observations may be dependent within days (or day by subject combination) with the (Exponential or Gaussian) serial autocorrelation being a function of the time interval between observations (time = passed hours since the start of the day). The serial correlation pertains to successive signals. Observations of different days and/or subjects are independent.

(6) The LOCAL option adds an observational error to a time series structure: Variance of measurement error ($\sigma^2_{\epsilon_{(2)sdi}}$)

(c) Data: different measurements nested within days nested within subjects (3-level model).

```
PROC MIXED DATA=data;
CLASS id day signal dayorder diagnosis;
(1)MODEL affect = diagnosis /SOLUTION;
(2)RANDOM intercept /SUBJECT=id TYPE=UN ;
(3)RANDOM intercept /SUBJECT=day(id) TYPE=UN;
(5)(6) REPEATED dayorder / SUBJECT= id TYPE=SP(EXP or GAU) (passeddays) LOCAL;
RUN;
```

Annotations:

-Fixed Effects

(1) Inclusion of fixed effects in the model (e.g., diagnosis, time, other covariates).

-Random Effects

(2) Subject-level: between-subject variance ($\sigma^2_{r_{00i}}$) SUBJECT=id implies that observations may be dependent within subjects; observations of different subjects are independent

(3) Day-level: long-term between-day variance ($\sigma^2_{r_{0di}}$) SUBJECT=day(id) implies that observations may be dependent within days (or day by subject combinations); observations of different days or subjects are independent

-Errors

(5) SUBJECT=id TYPE=SP(EXP or GAU) (passeddays): serial autocorrelation component ($\epsilon_{(1)mdi}$ with θ and τ^2). Note that this SUBJECT statement is different compared with the previous scenario! SUBJECT=id implies that observations may be dependent within subjects with the (Exponential or Gaussian) serial autocorrelation being a function of the time interval between observations (passeddays = passed days since the start of the study). The serial correlation pertains to successive days (measurements are taken at the same time within each day). Observations of different subjects are independent.

(6) The LOCAL option adds an observational error to a time series structure: Variance of measurement error ($\sigma^2_{\epsilon_{(2)mdi}}$)

(d) Data: different days nested within subjects (2-level model).

```
PROC MIXED DATA=data;
CLASS id day signal dayorder diagnosis;
(1)MODEL affect = diagnosis /SOLUTION;
(2)RANDOM intercept /SUBJECT=id TYPE=UN ;
(5)(6) REPEATED dayorder / SUBJECT=id TYPE=SP(EXP or GAU) (passeddays) LOCAL;
RUN;
```

Annotations:

-Fixed Effects

(1) Inclusion of fixed effects in the model (e.g., diagnosis, time, other covariates)

-Random Effects

(2) Subject-level: between-subject variance ($\sigma^2_{r_{0i}}$) SUBJECT=id implies that observations may be dependent within subjects; observations of different subjects are independent

-Errors

(5) SUBJECT=id TYPE=SP(EXP or GAU) (time): serial autocorrelation component ($\epsilon_{(1)di}$ with θ and τ^2) SUBJECT= id implies that observations may be dependent within subjects with the (Exponential or Gaussian) serial autocorrelation being a function of the time interval between observations (passeddays = passed days since the start of the study). The serial correlation pertains to successive days. Observations of different subjects are independent.

(6) The LOCAL option adds an observational error to a time series structure: Variance of measurement error ($\sigma^2_{\epsilon_{(2)di}}$)