Package: SleepCycles (via r-universe)

September 6, 2024

Title Sleep Cycle Detection

Version 1.1.4

Description Sleep cycles are largely detected according to the
originally proposed criteria by Feinberg & Floyd (1979)
<doi:10.1111/j.1469-8986.1979.tb02991.x> as described in Blume
& Cajochen (2021) <doi:10.1016/j.mex.2021.101318>.

License GPL-3

Encoding UTF-8

Imports ggplot2, reshape2, plyr, stringr, viridis

Language en-GB

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.1

Depends R (>= 2.10)

Suggests knitr, rmarkdown

VignetteBuilder knitr

Repository https://christineblume.r-universe.dev

RemoteUrl https://github.com/christineblume/sleepcycles

RemoteRef HEAD

RemoteSha 8099e500c17bbecd482238ab93a4e8f86068d70c

Contents

SleepCycles   *Sleep Cycle Detection*

Description

Sleep cycles are largely detected according to the originally proposed criteria by Feinberg & Floyd (1979) and as described in Blume & Cajochen (2020) [doi:10.31219/osf.io/r2q8v](doi:10.31219/osf.io/r2q8v) from sleep staging results. NREM periods are periods starting with N1 (default) or N2 at the beginning of the night and W or another NREM stage following a REM period. NREMPs have a minimal duration of 15min (can include W, up to <5min REM, except for the first REMP, for which there is no minimum duration criterion). REM following a NREM period always represents a potential REM period (REMP), however any REMP must be at least 5min (except the first REMP, for which no minimum duration criterion is applied). If a NREMP exceeds 120min in duration (excl. wake), it can be split into 2 parts. The new cycle then starts with the first N3 episode following a phase (>12min) with any other stage than N3, that is a lightening of sleep (cf. Rudzik et al., 2020; Jenni et al., 2004; Kurth et al., 2010). The code makes suggestions where splitting could take place according to the criteria and visualises the potential splitting points on top of a hypnogram. The user can then interactively choose where to split the NREMP. However, the code also offers the possibility to provide a numeric value for an epoch at which to split or you can decide to not split at all. A combination of a NREMP and the following REMP represents one sleep cycle, except for the case when a NREMP is split. In this case, the first of the two resulting NREMPs represents a sleep cycle (without REM).

The function requires any sleep staging results file with a column, in which the sleep stages are coded in the usual 0,1,2,3,5 (i.e., W, N1, N2, N3, REM) pattern (i.e., a numeric vector). The user can define other integers to be handled as W or N3 (i.e. in the case stagings were done according to the Rechtschaffen and Kales criteria including S3 and S4). The presence of further columns in the data is not an issue. Staging must be in 30s epochs. Besides text files, it can also handle csv files and marker files for the Brain Vision Analyzer (filetype = "txt" (default), "csv", or "vmrk").

Usage

```
SleepCycles(
  p,
  sleepstart = "N1",
  files = NA,
  filetype = "txt",
  treat_as_W = NA,
  treat_as_N3 = NA,
  rm_incomplete_period = FALSE,
  plot = TRUE,
  REMP_length = 10
)
```

Arguments

p   character vector indicating the directory containing the sleep staging files

sleepstart	character vector indicating whether the first NREMP at the beginning of the night should start with N1 or N2. Default: N1
files	numeric vector indicating which files in 'p' to process. Default: NA
filetype	character indicating file type of the files containing the sleep staging results. Can be "txt" (default) or "csv", or "vmrk" (i.e., marker files for Brain Vision Analyzer Software).
treat_as_W	numeric vector indicating which values should be treated as 'wake'. Default: NA
treat_as_N3	numeric vector indicating which values should be treated as 'N3'. Default: NA
rm_incomplete_period	
	logical: should incomplete period at the end of the night be removed? Default: FALSE.
plot	logical: should a plot for the result of the detection procedure be generated and saved? Default: TTRUE.
REMP_length	numeric value specifying the minimum duration of a REM period following the first REM period. Default is 10 segments (i.e. 5 minutes). Decreasing the min. length is not encouraged and should only be done following careful consideration.

Details

Besides sleep cycles (NREM-REM), the result also splits the NREM and REM parts of each cycle in percentiles. In case the length of a period is not divisible by 10 (e.g., 203 epochs), one epoch is added to percentiles in a randomized fashion to reach the correct length of a period (here: 7 percentiles of 20 epochs, 3 of 21 epochs).

The code offers to choose whether incomplete periods should be removed at the end of the night (rm_incomplete_period, default = F). Incomplete periods are defined by cycles that are followed by <5min NREM or W (e.g. because a participant is woken up).

Although this is not encouraged, for some participants it may be necessary to decrease the minimum duration of REM from 5min to 4 or 4.5min as otherwise a seemingly 'clear' REM period is skipped. While the default length of REMPs is 10 segments, it can be decreased.

The user can either process all files in a given directory (default) or specific files by specifying a vector of files.

By default, the function produces and saves a plot for visual inspection of the results.

Value

Saves results of the detection in a results folder in 'p'. The resulting textfile contains the sleepstages in a column named 'SleepStages', the sleep cycles in a column 'SleepCycles' (numeric value indicating the cycle number), information on whether it is a NREM or REM period (numeric value in column 'N_REM', 0 = NREM, 1 = REM), and an indicator of the percentiles of the (N)REM period of the cycle (numeric value in 'percentile' column; 1 = first percentile, 2 = second percentile, etc.). In case a (N)REM period is less than 10 epochs long, no percentiles are calculated (all epochs are coded as '1' in the 'percentile' column).

References

Feinberg, I. and Floyd, T.C. (1979), Systematic Trends Across the Night in Human Sleep Cycles. Psychophysiology, 16: 283-291. https://doi.org/10.1111/j.1469-8986.1979.tb02991.x

Rudzik, F., Thiesse, L., Pieren, R., Heritier, H., Eze I.C., Foraster, M., Vienneau, D., Brink, M., Wunderli, J.M., Probst-Hensch, N., Roeoesli, M., Fulda, S., Cajochen, C. (2020). Ultradian modulation of cortical arousals during sleep: effects of age and exposure to nighttime transportation noise. Sleep, Volume 43, Issue 7. https://doi.org/10.1093/sleep/zsz324

Jenni, O.E., Carskadon, M.A. (2004). Spectral Analysis of the Sleep Electroencephalogram During Adolescence. Sleep, Volume 27, Issue 4, Pages 774-783. https://doi.org/10.1093/sleep/27.4.774

Kurth, S., Ringli, M., Geiger, A., LeBourgeois, M., Jenni, O.G., Huber, R. (2010). Mapping of Cortical Activity in the First Two Decades of Life: A High-Density Sleep Electroencephalogram Study. Journal of Neuroscience. 30 (40) 13211-13219; DOI: 10.1523/JNEUROSCI.2532-10.2010

Examples

```
data(sleepstages)
olddir <- getwd()
newdir <- file.path(tempdir(),"SleepCycles_exmpl")
dir.create(newdir, showWarnings = FALSE)
write.table(sleepstages, file = paste(newdir, "sleepstages.vmrk", sep = "/"),
row.names=FALSE, col.names = FALSE, quote = FALSE, sep = ",")
SleepCycles(newdir, filetype = "vmrk")
setwd(olddir)

## Not run:
# Dataset that requires splitting of a NREMP
data(sleepstages2)
olddir <- getwd()
newdir <- file.path(tempdir(),"SleepCycles_exmpl2")
dir.create(newdir, showWarnings = FALSE)
write.table(sleepstages2, file = paste(newdir, "sleepstages2.txt", sep = "/"),
            row.names=FALSE, col.names = TRUE, quote = FALSE, sep = ",")
SleepCycles(newdir, filetype = "txt")
setwd(olddir)

## End(Not run)
```

---

sleepstages   *Sleepstaging from one participant.*

Description

A dataset containing sleep staging result for one participant. In this case, no NREM period exceeds 120min (excl. wake), wherefore no splitting is initiated. The variables are as follows:

Usage

```
sleepstages
```

Format

A vmrk file (can be read as a text file) with 954 rows and 2 variables:

Type Describes what column 'Description' shows

Description Gives the sleep stage according to AASM criteria. 0 = wake, 1 = N1, 2 = N2, 3 = N3, 5 = W

---

sleepstages2	*Sleepstaging from one participant.*

Description

A dataset containing sleep staging result for one participant. In this case, a NREM period exceeds 120min (excl. wake), wherefore splitting is initiated. The variables are as follows:

Usage

```
sleepstages2
```

Format

A vmrk file (can be read as a text file) with 959 rows (including one header row) and 2 variables:

Type Describes what column 'Description' shows

Description Gives the sleep stage according to AASM criteria. 0 = wake, 1 = N1, 2 = N2, 3 = N3, 5 = W

Index