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Advancing movement & sleep research

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GGIR training: Day 3

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BEFORE WE START

- Focus of this course
- Questions
- Video recording
- Slides + Documentation + Example data:
<https://www.accelting.com/ggir-training-materials/>

Day 2: questions?



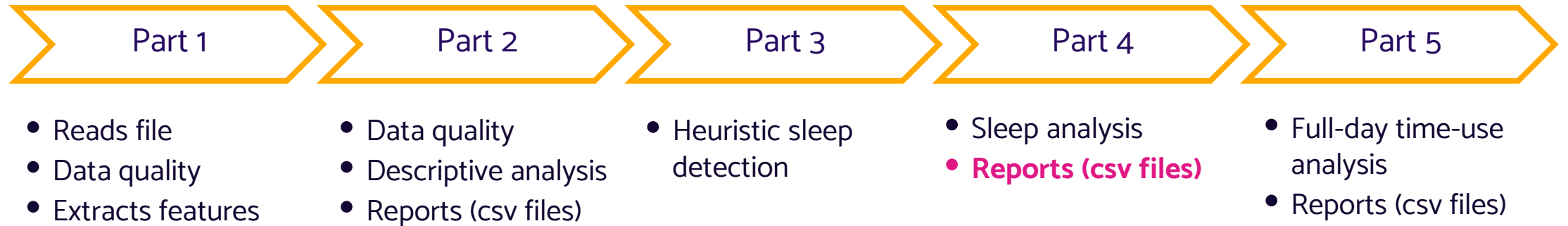
Learning goals for this session

- Navigate the Part 4 Output.
- Understand what GGIR can do to assess physical activity and 24 time-use.
- How to do this yourself
- How to get help

Part 3 & 4 Output



The GGIR pipeline



Output from Part 4

Night-level features (full report)

ID	Onset_n1	Wakeup_n1	Onset_n2	Wakeup_n2	Onset_n3	...
01	23:00:00	07:00:00			23:15:00	...

part4_nightsummary_sleep_full.csv

ID	night	cleaningcode	sleeplog_used	acc_available	guider
1	1	0	1	1	sleeplog
1	2	1	0	1	HDCZA
1	3	0	1	1	sleeplog
1	4	0	1	1	sleeplog
1	5	0	1	1	sleeplog
1	6	0	1	1	sleeplog
1	7	2	1	0	sleeplog

Cleaning code	Meaning
0	No problem
1	Sleep log not available (HDCZA used)
2	Not enough valid data
3	No accelerometer data available
4	No nights to be analyzed
5	Guider-defined SPT
6	SPT could not be defined either by sleeplog or algorithms

Output from Part 4

Night-level features (full report)

do.report = 4

part4_nightsummary_sleep_full.csv

ID	night	sleeponset	wakeup	SptDuration	SleepDurationInSpt	WASO
1	1	27.201	32	4.799	3.696	1.103
1	2	26.11	31.936	5.826	4.888	0.939
1	3	26.5	32	5.5	4.997	0.503
1	4	25	32.475	7.475	7.115	0.36
1	5	26.413	32	5.588	5.071	0.517
1	6	27.131	32	4.869	3.526	1.343
1	7	25.074	31.761	6.688	6	0.688

Output from Part 4

Night-level features (clean report)

`do.report = 4`

GGIR(
[...]
Data cleaning
includenightcrit = 16,
excludefirst.part4 = FALSE,
excludelast.part4 = FALSE,
[...])

part4_nightsummary_sleep_cleaned.csv

ID	night	sleeponset	wakeup	SptDuration	SleepDurationInSpt	WASO
1	1	27.201	32	4.799	3.696	1.103
1	2	26.11	31.936	5.826	4.888	0.939
1	3	26.5	32	5.5	4.997	0.503
1	4	25	32.475	7.475	7.115	0.36
1	5	26.413	32	5.588	5.071	0.517
1	6	27.131	32	4.869	3.526	1.343
1	7	25.074	31.761	6.688	6	0.688

Output from Part 4

Night-level features (clean report)

do.report = 4

GGIR(

[...]

Data cleaning

includenightcrit = 16,

excludefirst.part4 = **TRUE**,

excludelast.part4 = FALSE,

[...])

part4_nightsummary_sleep_cleaned.csv

ID	night	sleeponset	wakeup	SptDuration	SleepDurationInSpt	WASO
1	1	27.201	32	4.799	3.696	1.103
1	3	26.5	32	5.5	4.997	0.503
1	4	25	32.475	7.475	7.115	0.36
1	5	26.413	32	5.588	5.071	0.517
1	6	27.131	32	4.869	3.526	1.343

Output from Part 4

Night-level features (clean report)

do.report = 4

GGIR(

[...]

Data cleaning

includenightcrit = 16,

excludefirst.part4 = **TRUE**,

excludelast.part4 = FALSE,

[...])

part4_nightsummary_sleep_cleaned.csv

ID	night	sleeponset	wakeup	SptDuration	SleepDurationInSpt	WASO
1	1	27.201	32	4.799	3.696	1.103
1	3	26.5	32	5.5	4.997	0.503
1	4	25	32.475	7.475	7.115	0.36
1	5	26.413	32	5.588	5.071	0.517
1	6	27.131	32	4.869	3.526	1.343

Output from Part 4

Person-level features

do.report = 4

part4_summary_sleep_cleaned.csv

ID	sleeplog_used	n_nights_acc	n_nights_sleeplog	n_WE_nights_complete	n_WD_nights_complete	n_WEnights_daysleeper	n_WDnights_daysleeper
11	1	6	6	2	4	0	0

ID	SptDuration_ AD _T5A5_mn	SptDuration_ AD _T5A5_sd	SleepDurationInSpt_ AD _T5A5_mn	SleepDurationInSpt_ AD _T5A5_sd	WASO_ AD _T5A5_mn	WASO_ AD _T5A5_sd
11	5.372	1.142	4.685	1.375	0.687	0.383

ID	SptDuration_ WD _T5A5_mn	SptDuration_ WD _T5A5_sd	SleepDurationInSpt_ WD _T5A5_mn	SleepDurationInSpt_ WD _T5A5_sd	WASO_ WD _T5A5_mn	WASO_ WD _T5A5_sd
11	5.64	1.277	5.045	1.404	0.594	0.34

ID	SptDuration_ WE _T5A5_mn	SptDuration_ WE _T5A5_sd	SleepDurationInSpt_ WE _T5A5_mn	SleepDurationInSpt_ WE _T5A5_sd	WASO_ WE _T5A5_mn	WASO_ WE _T5A5_sd
11	4.838	0.877	3.966	1.409	0.872	0.532

Output from Part 4

Complete list of variables

Sleeponset, sleeponset_ts

Wakeup, wakeup_ts

SptDuration

Sleepparam

guider_inbedStart, guider_inbedStart_ts

guider_inbedEnd, guider_inbedEnd_ts

guider_inbedDuration

fraction_night_invalid

SleepDurationInSpt

WASO

duration_sib_wakinghours

number_sib_sleepperiod

number_of_awakenings

number_sib_wakinghours

duration_sib_wakinghours_atleast15min

sleeplatency

sleepefficiency

page

daysleeper

weekday

calendar_date

filename

cleaningcode

sleeplog_used

acc_available

guider

SleepRegularityIndex

SriFractionValid

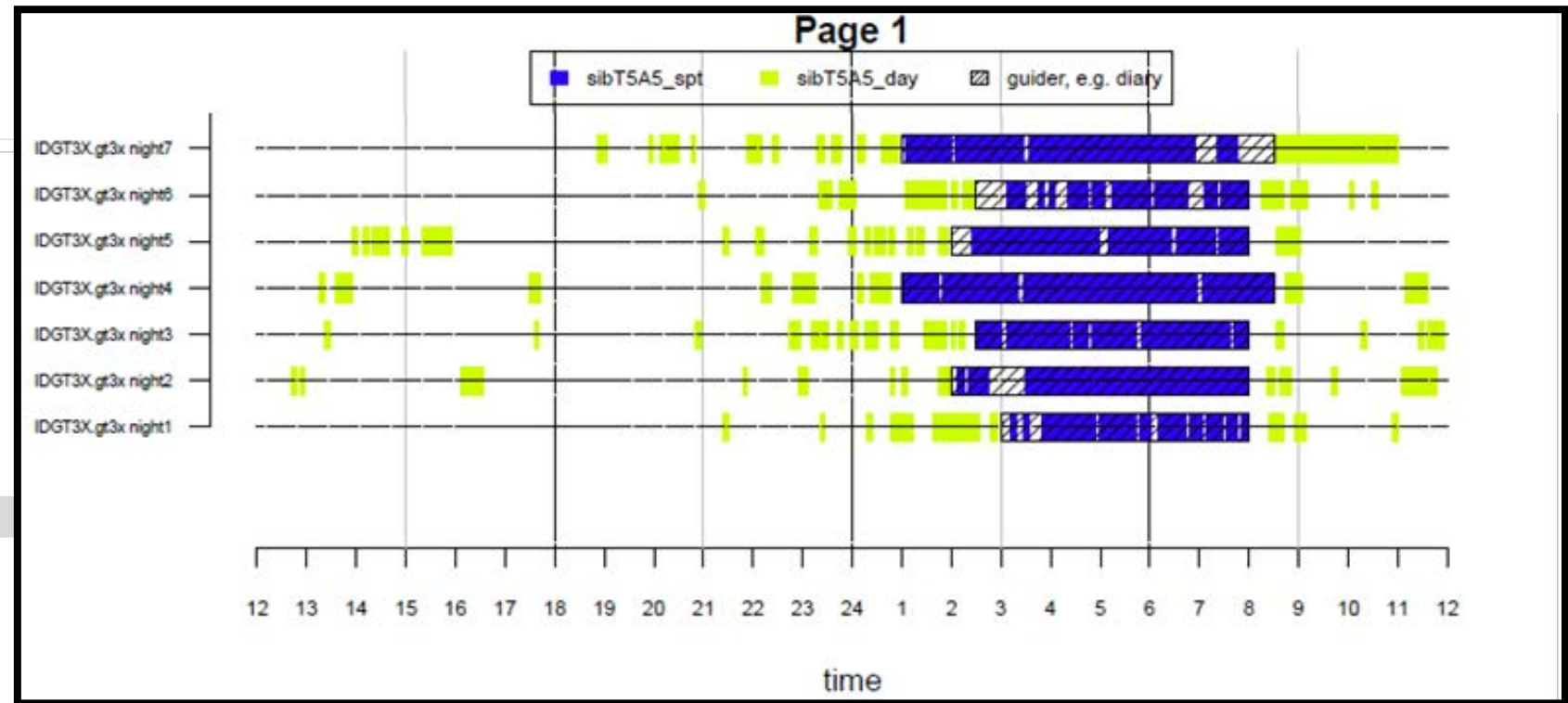
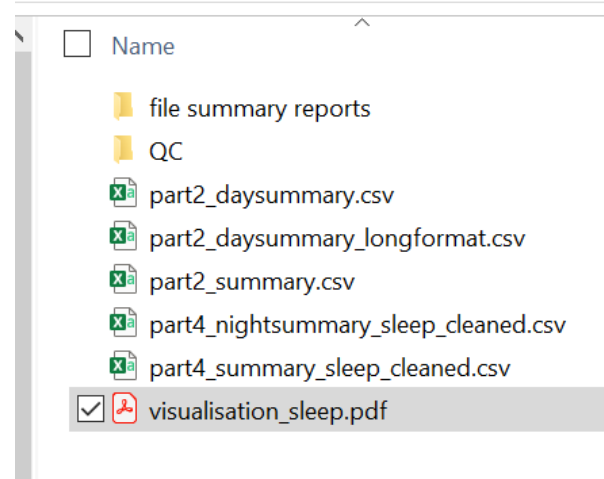
longitudinal_axis

nonwear_perc_spt

Sleep visualizations

do.visual = TRUE

est files > output > output_GT3X > results

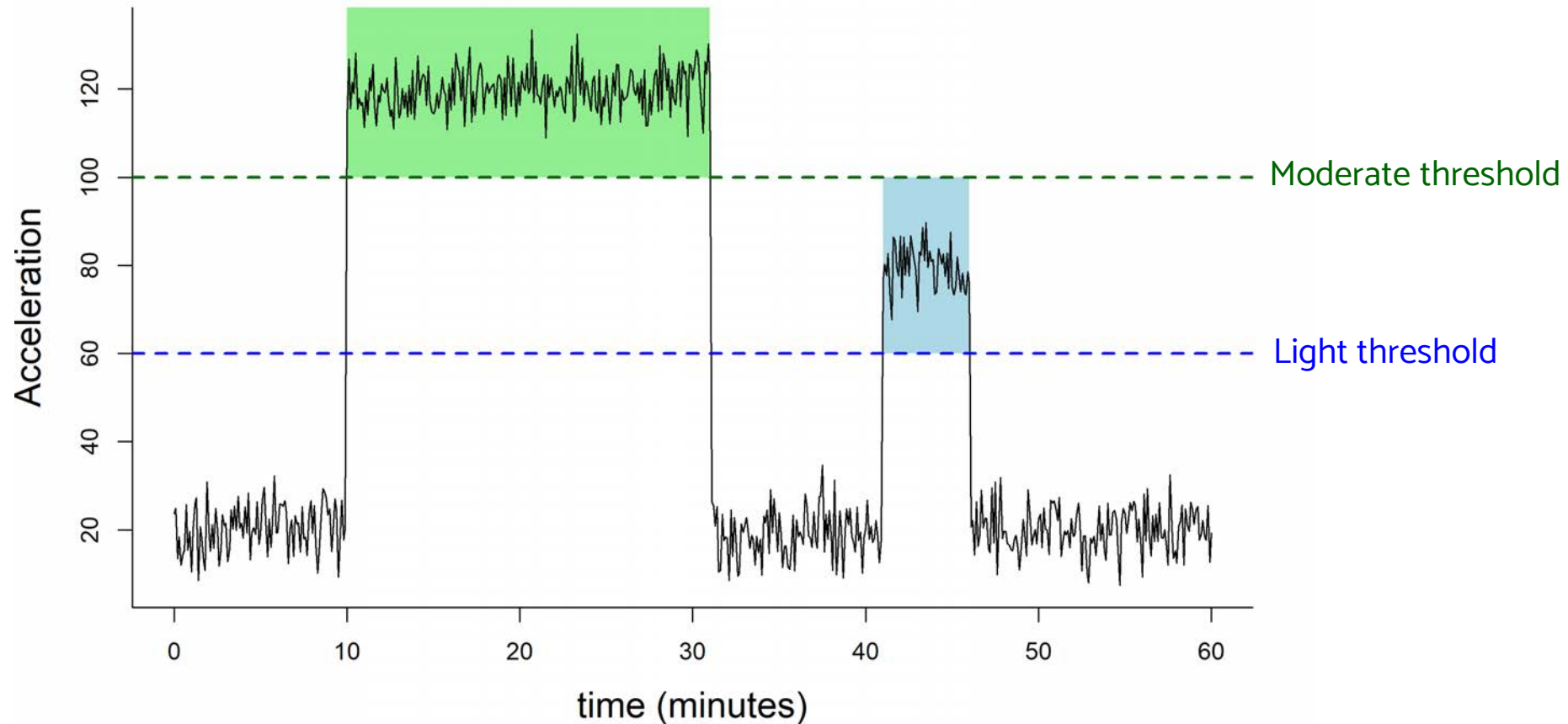


Cut-points & Bouts



Physical activity intensity: cut-points

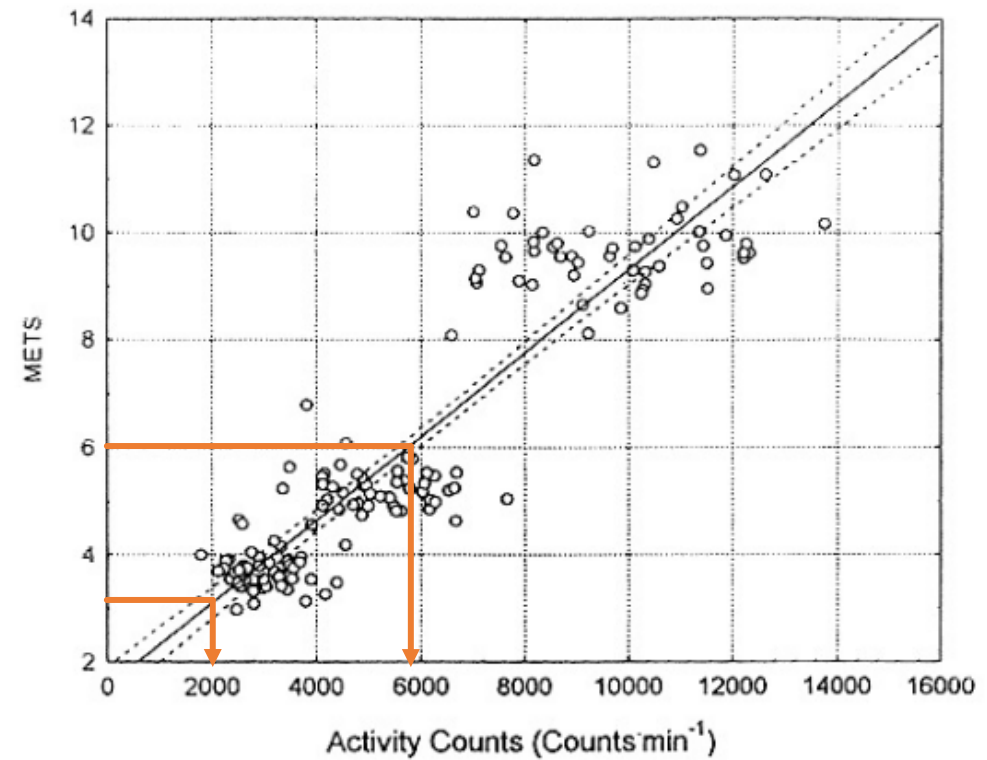
1. Time above threshold



Physical activity intensity



Linear regression



Why do we want to detect bouts

- Indicator of time spent in activities involving aerobic energy metabolism
- Consistent with historical self-report data
- To aid studying of fragmentation of behaviour

Defining what a bout/sojourn is

1. What should the cut-point be?
2. What should the epoch length be?
3. What should minimum duration of bout (sojourn) be?
4. Should we allow for gaps in a bout (sojourn)?
5. Should this be a percentage of the bout duration, an absolute minimum in seconds, or both?
6. Are bout gaps counted towards the time spent in bouts?
7. Do the first and last epoch need to meet the threshold criteria?
8. In what order are the bouts extracted?
9. How many bout categories should there be?

Implementation in GGIR

User decides on:

- Acceleration thresholds for light, moderate, and vigorous intensity
- Fraction of time for which cut-point criteria need to be met (light, inactive, MVPA)
- Bout duration ranges, e.g. [1, 5) [5, 10) and [10, ∞) minutes
- Epoch length

User does NOT decide on:

- Maximum bout gap of 1 minute
- First and last epoch need to meet cut-point criteria
- Number of intensity levels, which are always: inactive, light and MVPA
- Order in which bouts are calculated (1 MVPA; 2 inactive; 3 Light)
- Default code for detecting bout:
<https://github.com/wadpac/GGIR/blob/master/R/g.getbout.R>

Bouts of physical activity/inactivity

2. Bouts detection:

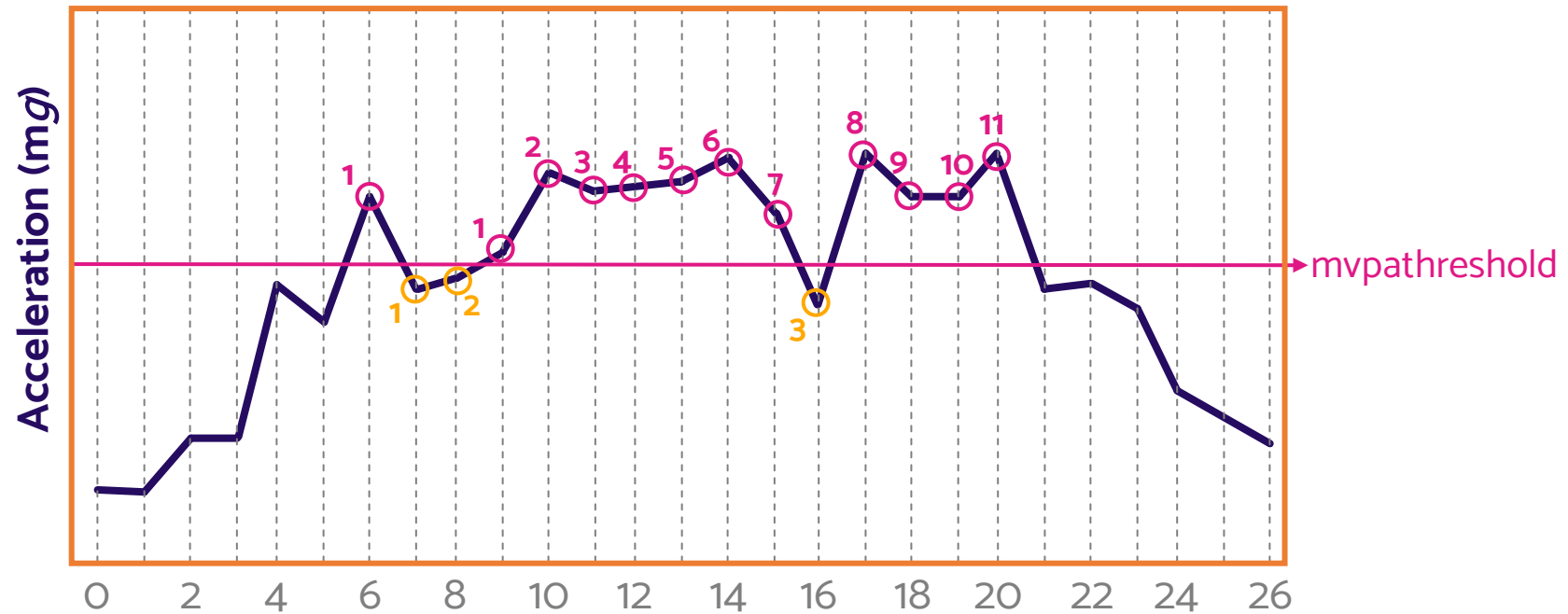
- $\text{mvpathreshold} = 100$
- $\text{boutdur} = 10$ ✓
- $\text{boutcriter} = 0.8$ ✓

Is this a MVPA bout?

Time above mvpathreshold
without gaps lasting longer than
1 minute = 11 min
Below mvpathreshold = 1 min

Rate

$$x = \frac{11}{12} = 0.92$$



Why does GGIR facilitates bout detection?

- Guidelines mainly based:
 - 1-min epoch
 - Data from hip-worn sensors... but bouts might be useful for:
 - 5-s epochs
 - Data from wrist-worn sensors to smooth out spontaneous movements
- Guidelines based on:
 - Specific health outcomes... but bouts might be relevant for:
 - health outcomes not covered by current research
- Bouts might be useful to investigate fragmentation of behavior
- We aim to be neutral in the discussion and try to facilitate all approaches

The cut-points annex

1 Considerations

2 Relevant arguments to use cut-points in GGIR

3 Summary of published cut-points

4 Notes on cut-point validity

5 References

Published cut-points and how to use them in GGIR



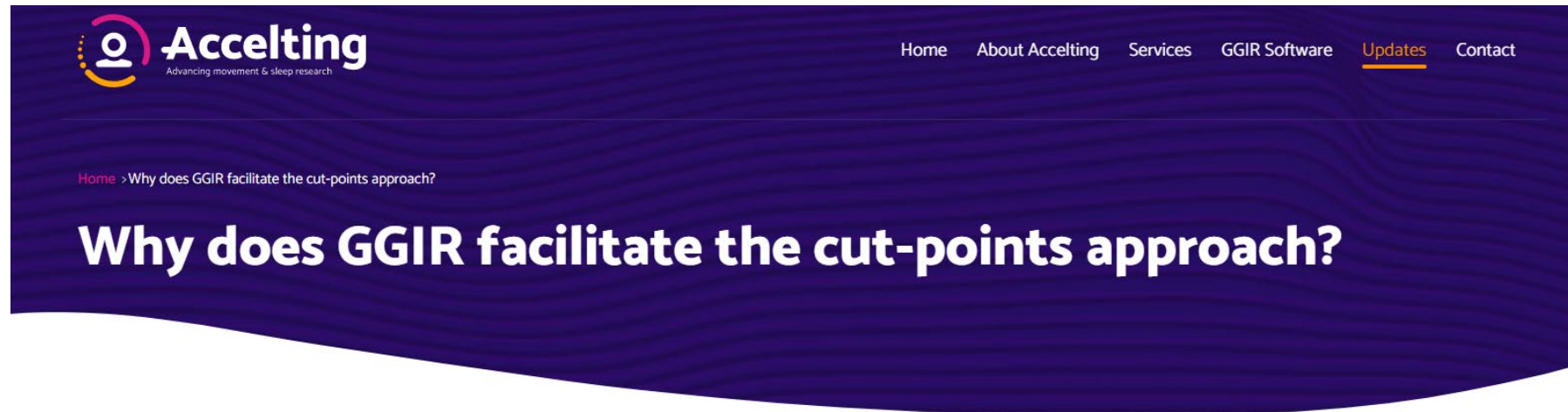
See also complementary vignettes on: [General introduction to GGIR](#), [Day segment analyses](#), [GGIR parameters](#), [Embedding external functions \(pdf\)](#), and [Reading ad-hoc csv file formats](#).

1 Considerations

The physical activity research field has used so called cut-points to segment accelerometer time series based on level of intensity. In this vignette we have compiled a list of published cut-points with instructions on how to use them with GGIR. Please note that GGIR refers to cut-points as thresholds, but we are referring to the same thing: A value or a set of values to help split levels of movement intensity. As newer cut-points are frequently published the list below may not be up to date. **Please let us know if you are aware of any published cut-points that we missed!**

<https://wadpac.github.io/GGIR/articles/CutPoints.html>

More reflections on the use of cut-points



Tuesday, August 2, 2022

The 'cut-points' approach is one of the most criticized analytical approaches in the field of physical activity research. Despite the criticism, cut-points are still widely used. R package **GGIR** facilitates the use of cut-points and by that contributes to the continued use of cut-points. So, you may wonder: Why does GGIR facilitate such a controversial method? Do the people behind GGIR not know about the limitations of cut-points? To answer these questions, it may be good that I first explain what the 'cut-points' approach is.

What is the cut-points approach?

Wearable accelerometer data can be processed towards an indicator of body acceleration over time. Although acceleration is a meaningful kinematic indicator, researchers have not incorporated acceleration directly into physical activity guidelines. Instead, the research community prefers to phrase physical activity guidelines in terms of time spent in levels of energy expenditure. Levels of energy expenditure are defined based on a construct named Metabolic Equivalent of Task (MET).



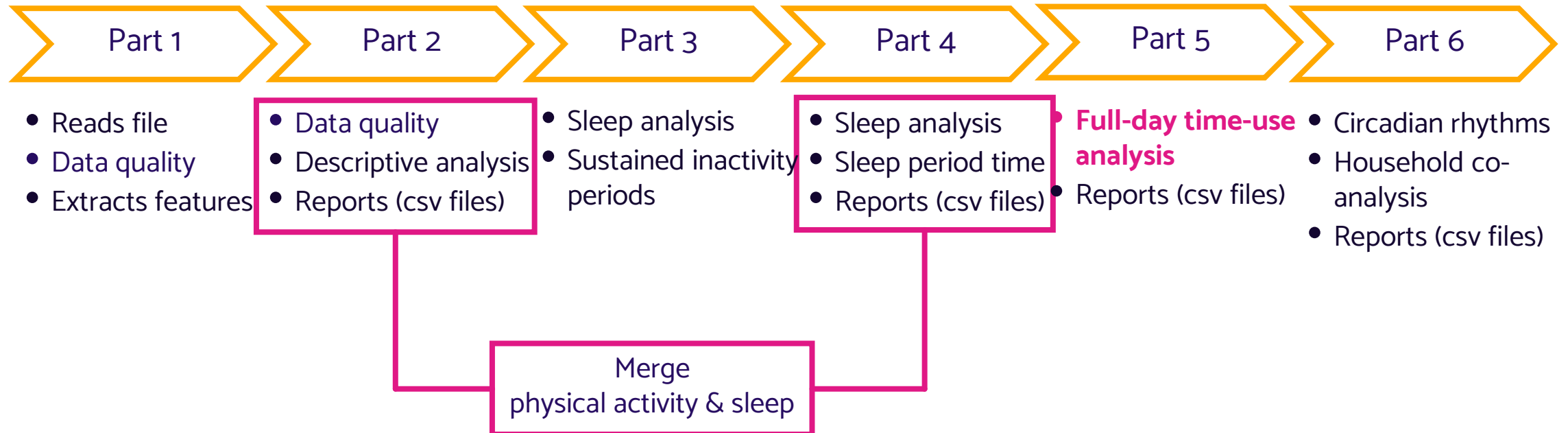
Photo: by Gabriela on Unsplash

<https://www.accelting.com/updates/why-does-ggir-facilitate-cut-points/>

Full-day time-use analysis



The GGIR pipeline



Part 5: Full-day time use

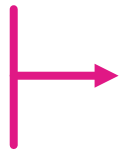
What it does

- Loads imputed acceleration data from part 2
- Loads sleep information from part 4 (SPT windows)
- Re-calculate variables based on the merged data (split by SPT & waking hours)
- Part 5 reports includes:
 - Daytime variables: physical activity intensities, inactivity
 - Nighttime variables: sleep indicators

Part 5: Full-day time use

Daily window definition

- Definition of day duration
 - Midnight-to-midnight
 - dayborder = 3 am
 - Waking-up to waking up
 - Sleep Onset to sleep Onset

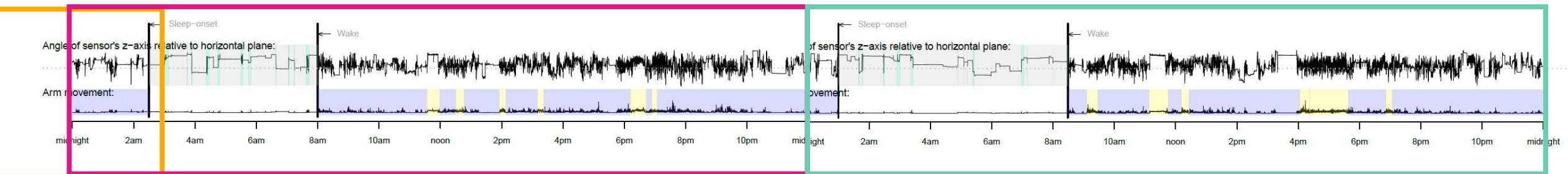


Same as in part 2

Thursday

Friday

Saturday

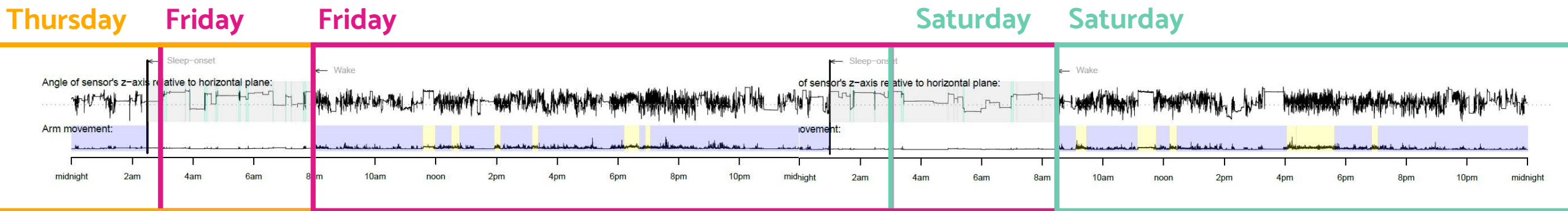


Part 5: Full-day time use

Daily window definition

- Definition of day duration
 - Midnight-to-midnight
 - dayborder = 3 am
 - Waking-up to waking up
 - Sleep Onset to sleep Onset

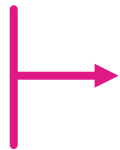
Same as in part 2



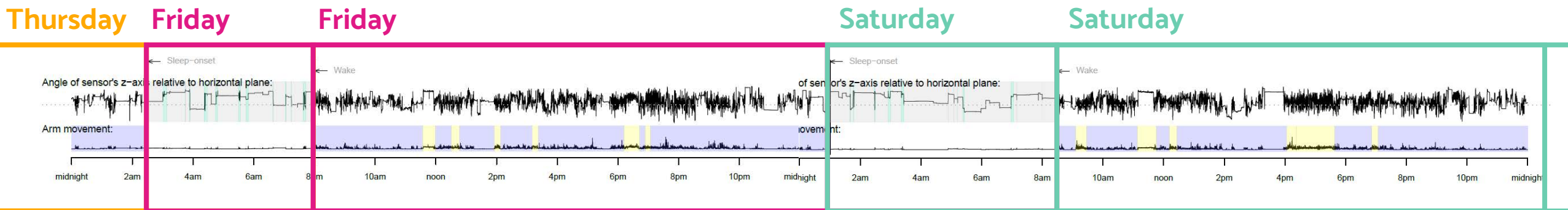
Part 5: Full-day time use

Daily window definition

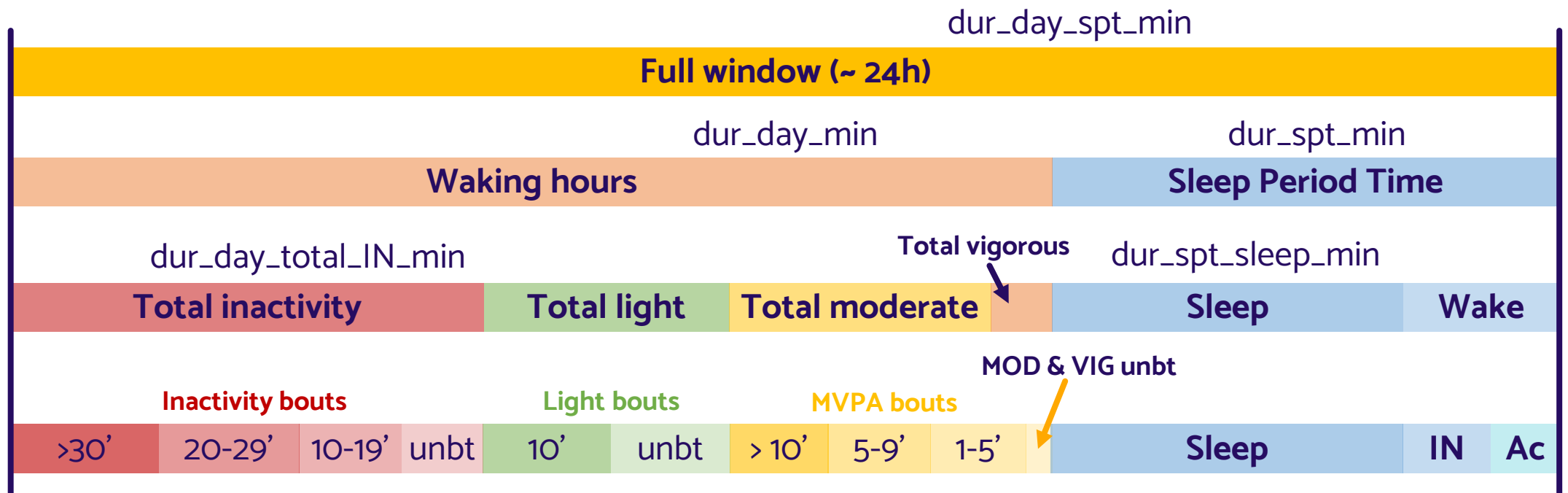
- Definition of day duration
 - Midnight-to-midnight
 - dayborder = 3 am
 - Waking-up to waking up
 - Sleep Onset to sleep Onset



Same as in part 2



Part 5: Full-day time use



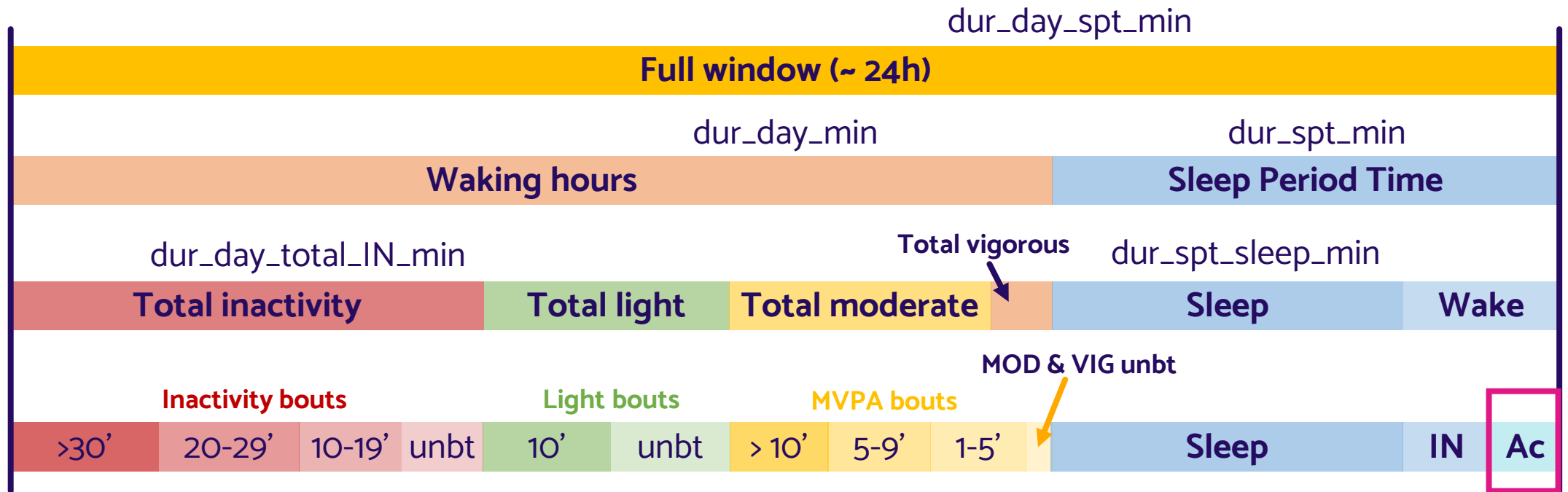
Min/day in each category (dur_)

Mean acceleration in each category (ACC_)

Number of bouts (Nbouts)

Number of blocks (Nblocks)

Part 5: Full-day time use



Min/day in each category (dur_)

Mean acceleration in each category (ACC_)

Number of bouts (Nbouts)


Number of blocks (Nblocks)

Part 5: Full-day time use

Similar variables but not identical variables relative to part 2

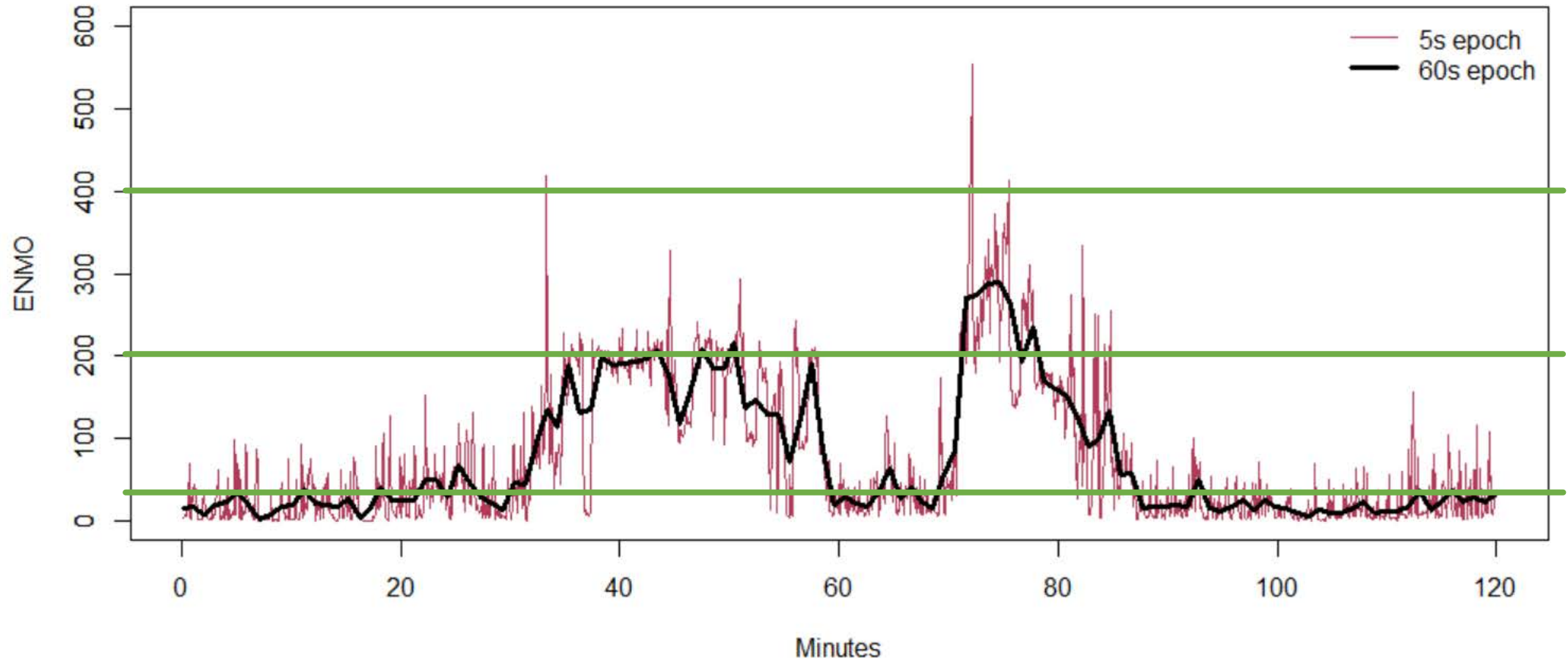
- Average acceleration
- Bouts of MVPA

Why MVPA minutes do not exactly match in part 2 and part 5?

- Different window definition
- Activity minutes occurring during SPT
- Bouts calculation ↔ Full-day window definition
- Re-definition of epoch length?  `part5_agg2_60seconds = TRUE`

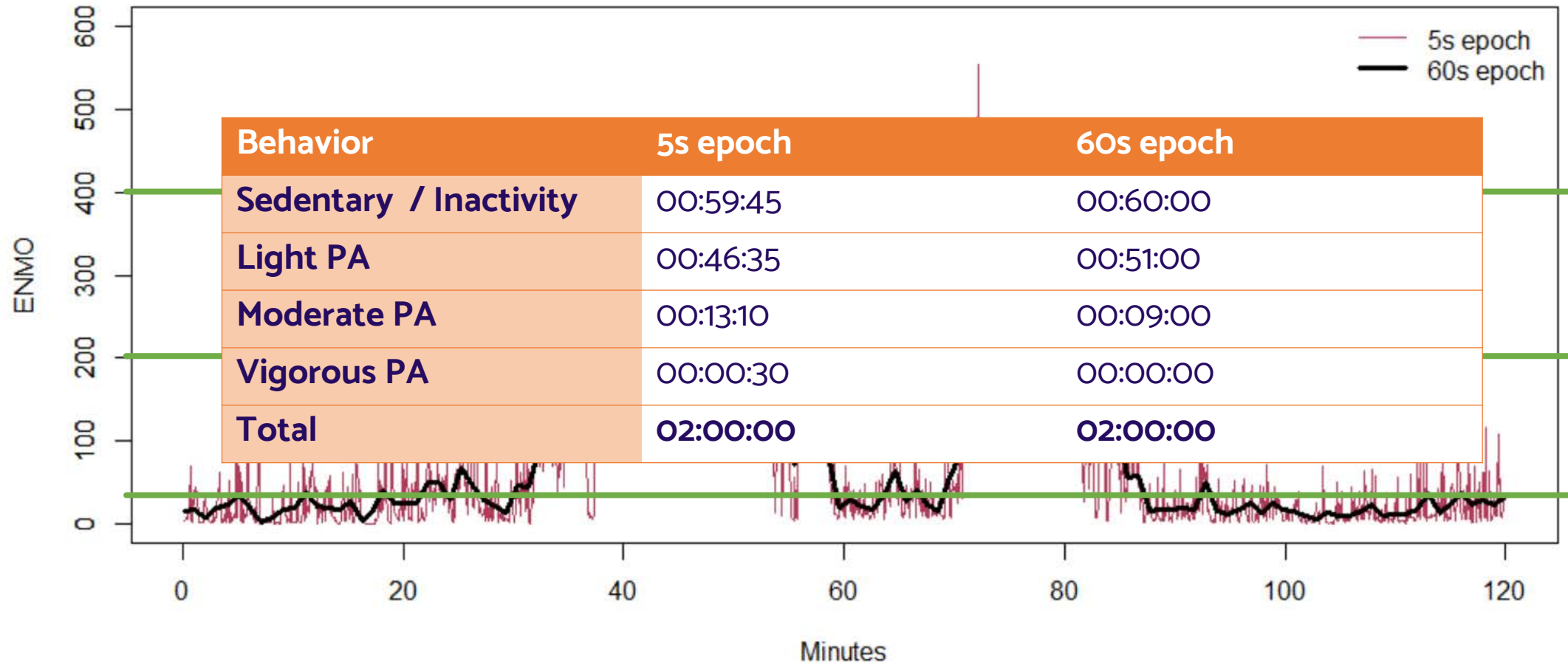
Epoch length in part 5

```
GGIR(# general settings  
[...]  
# data quality and metrics  
windowsizes = c(5, 900, 3600),  
part5_agg2_60seconds = TRUE,  
[...])
```



Epoch length in part 5

```
GGIR(# general settings  
[...]  
# data quality and metrics  
windowsizes = c(5, 900, 3600),  
part5_agg2_60seconds = TRUE,  
[...])
```



Part 5: Full-day time use

New variables (not in part 2)

- Inactivity
- Light physical activity
- Moderate physical activity
- Vigorous physical activity
- Bouts of inactivity and light physical activity

The GGIR()

Full-day time-use analysis

GGIR(

[...]

Physical activity and Inactivity thresholds

threshold.lig = 40, threshold.mod = 100, threshold.vig = 400,

It can be more than one threshold

threshold.lig = c(20, 40), threshold.mod = c(100, 120), threshold.vig = 400,

Bout durations

boutdur.in = c(10, 20, 30), boutdur.lig = 10, boutdur.mvpa = c(1, 5, 10),

Fraction of a bout that needs to meet the thresholds

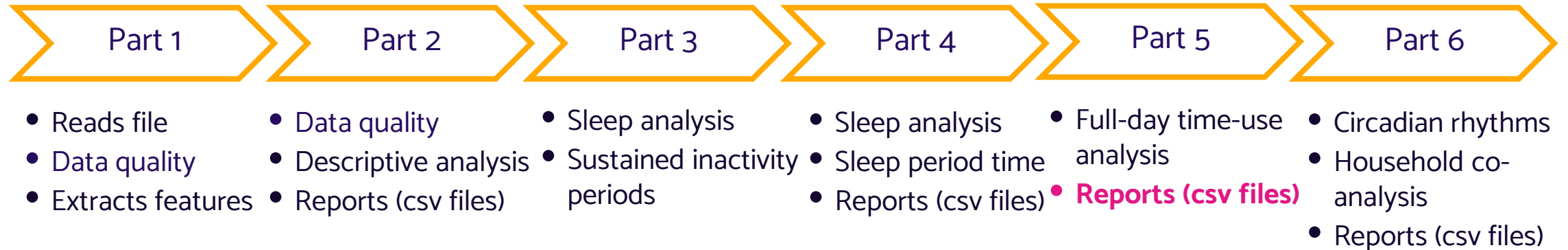
boutcriter.in = 0.9, boutcriter.lig = 0.8, boutcriter.mvpa = 0.8,

[...])

Part 5 Output



The GGIR pipeline



Output from Part 5

Day-level features (full report)

`do.report = 5`

GGIR(

[...]

Data cleaning

includedaycrit.part5 = 2/3,

[...])



66% of the waking hours available
(wearing the device)

part5_daysummary_full-MM-L40M100V400-T5A5.csv

ID	window_number	weekday	calendar_date	cleaningcode	acc_available	guider	nonwear_perc_day	nonwear_perc_spt	nonwear_perc_day_spt
1	1	Saturday	7/7/2014	0	1	sleeplog	3	84	30
1	2	Sunday	8/7/2014	1	1	HDCZA	0	0	0
1	3	Monday	9/7/2014	0	1	sleeplog	0	0	0
1	4	Tuesday	10/7/2014	0	1	sleeplog	0	0	0
1	5	Wednesday	11/7/2014	0	1	sleeplog	10	0	6.667
1	6	Thursday	12/7/2014	0	1	sleeplog	0.4	0	0.267
1	7	Friday	13/7/2014	2	1	sleeplog	68	0	45.334

Output from Part 5

Day-level features (full report)

`do.report = 5`

GGIR(

[...]

Data cleaning

includedaycrit.part5 = 2/3,

[...])



66% of the waking hours available
(wearing the device)

part5_daysummary_MM_L4OM100V400-T5A5.csv

ID	window_number	weekday	calendar_date	cleaningcode	acc_available	guider	nonwear_perc_day	nonwear_perc_spt	nonwear_perc_day_spt
1	1	Saturday	7/7/2014	0	1	sleeplog	3	84	30
1	2	Sunday	8/7/2014	1	1	HDCZA	0	0	0
1	3	Monday	9/7/2014	0	1	sleeplog	0	0	0
1	4	Tuesday	10/7/2014	0	1	sleeplog	0	0	0
1	5	Wednesday	11/7/2014	0	1	sleeplog	10	0	6.667
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1	7	Friday	13/7/2014	2	1	sleeplog	68	0	45.334

Output from Part 5

Day-level features (full report)

`do.report = 5`

GGIR(

[...]

Data cleaning

includedaycrit.part5 = 2/3,

excludefirstlast.part5 = FALSE,

[...])

part5_daysummary_MM_L4OM100V400_T5A5.csv

ID	window_number	weekday	calendar_date	cleaningcode	acc_available	guider	nonwear_perc_day	nonwear_perc_spt	nonwear_perc_day_spt
1	1	Saturday	7/7/2014	0	1	sleeplog	3	84	30
1	2	Sunday	8/7/2014	1	1	HDCZA	0	0	0
1	3	Monday	9/7/2014	0	1	sleeplog	0	0	0
1	4	Tuesday	10/7/2014	0	1	sleeplog	0	0	0
1	5	Wednesday	11/7/2014	0	1	sleeplog	10	0	6.667
1	6	Thursday	12/7/2014	0	1	sleeplog	0.4	0	0.267

Output from Part 5

Day-level features (full report)

do.report = 5

GGIR(

[...]

Data cleaning

includedaycrit.part5 = 2/3,

excludefirstlast.part5 = TRUE,

[...])

part5_daysummary_MM_L4OM100V400_T5A5.csv

ID	window_number	weekday	calendar_date	cleaningcode	acc_available	guider	nonwear_perc_day	nonwear_perc_spt	nonwear_perc_day_spt
1	1	Saturday	7/7/2014	0	1	sleeplog	3	84	30
1	2	Sunday	8/7/2014	1	1	HDCZA	0	0	0
1	3	Monday	9/7/2014	0	1	sleeplog	0	0	0
1	4	Tuesday	10/7/2014	0	1	sleeplog	0	0	0
1	5	Wednesday	11/7/2014	0	1	sleeplog	10	0	6.667
1	6	Thursday	12/7/2014	0	1	sleeplog	0.4	0	0.267

Part 5

Output

- meta
 - ms5.outraw
 - 40_100_400
 - 101_T5A5.Rdata
 - 101_T5A5.csv
 - behavioralcodes_YYYY-MM-DD.csv
- results
 - file summary reports
 - Report_101.pdf
 - QC
 - part5_dayssummary_full_MM_L40M100V400_T5A5.csv
 - part5_dayssummary_MM_L40M100V400_T5A5.csv
 - **part5_personsummary_MM_L40M100V400_T5A5.csv**

Output from Part 5

Person-level features (time-use)

do.report = 5

part5-personsummary_MM-L40M100V400-T5A5.csv

ID	Calendar_date	Nvaliddays	Nvaliddays_WD	Nvaliddays_WE	Ndaysleeper	Ncleaningcodezero	Ncleaningcode1	Nsleeplog_used	Nacc_available
11	24/08/2022	6	4	2	0	5	1	5	6

ID	nonwear_perc_day_pla	dur_spt_sleep_min_pla	dur_day_IN_unbt_min_pla	dur_day_MOD_unbt_min_pla	dur_day_VIG_unbt_min_pla	dur_day_MVPA_bts_10_min_pla	dur_day_MVPA_bts_5_10_min_pla	dur_day_total_MOD_min_pla	dur_day_total_VIG_min_pla
11	0	325.306	230.986	49.375	0.319	2.806	2.681	72.597	0.514

ID	nonwear_perc_day_wei	dur_spt_sleep_min_wei	dur_day_IN_unbt_min_wei	dur_day_MOD_unbt_min_wei	dur_day_VIG_unbt_min_wei	dur_day_MVPA_bts_10_min_wei	dur_day_MVPA_bts_5_10_min_wei	dur_day_total_MOD_min_wei	dur_day_total_VIG_min_wei
11	0	327.58	231.009	49.107	0.298	3.006	2.693	72.952	0.497

week_weekend_aggregate.part5 = TRUE

ID	nonwear_perc_day_WD	dur_spt_sleep_min_WD	dur_day_IN_unbt_min_WD	dur_day_MOD_unbt_min_WD	dur_day_VIG_unbt_min_WD	dur_day_MVPA_bts_10_min_WD	dur_day_MVPA_bts_5_10_min_WD	dur_day_total_MOD_min_WD	dur_day_total_VIG_min_WD
11	0	341.229	231.146	47.5	0.167	4.208	2.771	75.083	0.396

Output from Part 5

Person-level features (acceleration)

do.report = 5

part5-personsummary_MM-L40M100V400-T5A5.csv

ID	Calendar_date	Nvaliddays	Nvaliddays_WD	Nvaliddays_WE	Ndaysleeper	Ncleaningcodezero	Ncleaningcode1	Nsleeplog_used	Nacc_available
11	24/08/2022	6	4	2	0	5	1	5	6

Plain
avg

ID	ACC_day_total_ IN_mg_pla	ACC_day_total_ LIG_mg_pla	ACC_day_total_ MOD_mg_pla	ACC_day_total_ VIG_mg_pla	ACC_day_mg_pla	ACC_spt_mg_pla	ACC_day_spt_mg_pla
11	12.312	64.438	140.033	497.212	34.072	20.446	30.437

Weighted
avg

ID	ACC_day_total_ IN_mg_wei	ACC_day_total_ LIG_mg_wei	ACC_day_total_ MOD_mg_wei	ACC_day_total_ VIG_mg_wei	ACC_day_mg_wei	ACC_spt_mg_wei	ACC_day_spt_mg_wei
11	12.224	64.535	139.877	495.554	34.114	20.101	30.366

week_weekend_aggregate.part5 = TRUE

Weekday

ID	ACC_day_total_ IN_mg_WD	ACC_day_total_ LIG_mg_WD	ACC_day_total_ MOD_mg_WD	ACC_day_total_ VIG_mg_WD	ACC_day_mg_WD	ACC_spt_mg_WD	ACC_day_spt_mg_WD
11	11.694	65.119	138.941	485.61	34.365	18.034	29.945

Output from Part 5

Person-level features (acceleration)

do.report = 5

part5-personsummary_MM-L40M100V400-T5A5.csv

ID	Calendar_date	Nvaliddays	Nvaliddays_WD	Nvaliddays_WE	Ndaysleeper	Ncleaningcodezero	Ncleaningcode1	Nsleeplog_used	Nacc_available
11	24/08/2022	6	4	2	0	5	1	5	6

Plain
avg

ID	ACC_day_total_ IN_mg_pla	ACC_day_total_ LIG_mg_pla	ACC_day_total_ MOD_mg_pla	ACC_day_total_ VIG_mg_pla	ACC_day_mg_pla	ACC_spt_mg_pla	ACC_day_spt_mg_pla
11	12.312	64.438	140.033	497.212	34.072	20.446	30.437

Weighted
avg

ID	ACC_day_total_ IN_mg_wei	ACC_day_total_ LIG_mg_wei	ACC_day_total_ MOD_mg_wei	ACC_day_total_ VIG_mg_wei	ACC_day_mg_wei	ACC_spt_mg_wei	ACC_day_spt_mg_wei
11	12.224	64.535	139.877	495.554	34.114	20.101	30.366

week_weekend_aggregate.part5 = TRUE

Weekend
avg

ID	ACC_day_total_ IN_mg_WE	ACC_day_total_ LIG_mg_WE	ACC_day_total_ MOD_mg_WE	ACC_day_total_ VIG_mg_WE	ACC_day_mg_WE	ACC_spt_mg_WE	ACC_day_spt_mg_WE
11	11.694	65.119	138.941	485.61	34.365	18.034	29.945

Output from Part 5

Other variables

NIGHTTIME

N_atleast5minwakenight
Nblocks
dur_spt_wake_IN_min
dur_spt_wake_LIG_min
dur_spt_wake_MOD_min
dur_spt_wake_VIG_min

DAYTIME

Nbouts
Nblocks

FULL WINDOW

quantile_mostactive60min_mg
quantile_mostactive30min_mg
L5VALUE
M5VALUE
L5TIME_num
M5TIME_num
ig_gradient
ig_intercept
ig_rsquared
Fragmentation metrics

Output from Part 5

Other variables

NIGHTTIME

N_atleast5minwakenight
Nblocks
dur_spt_wake_IN_min
dur_spt_wake_LIG_min
dur_spt_wake_MOD_min
dur_spt_wake_VIG_min

DAYTIME

Nbouts
Nblocks

FULL WINDOW

quantile_mostactive60min_mg
quantile_mostactive30min_mg
L5VALUE
M5VALUE
L5TIME_num
M5TIME_num
ig_gradient
ig_intercept
ig_rsquared
Fragmentation metrics

Output from Part 5

Other variables

NIGHTTIME

N_atleast5minwakenight
Nblocks
dur_spt_wake_IN_min
dur_spt_wake_LIG_min
dur_spt_wake_MOD_min
dur_spt_wake_VIG_min

DAYTIME

Nbouts
Nblocks

FULL WINDOW

quantile_mostactive60min_mg
quantile_mostactive30min_mg
L5VALUE
M5VALUE
L5TIME_num
M5TIME_num
ig_gradient
ig_intercept
ig_rsquared
Fragmentation metrics

frag.metrics = "all"

<https://wadpac.github.io/GGIR/articles/GGIRoutput.html>

Output from Part 5

Fragmentation metrics

Nr. Of fragments

FRAG_Nfrag_IN_day
FRAG_Nfrag_LIPA_day
FRAG_Nfrag_MVPA_day
FRAG_Nfrag_PA_day
FRAG_Nfrag_IN2LIPA_day
FRAG_Nfrag_IN2MVPA_day

Transition probability

FRAG_TP_PA2IN_day
FRAG_TP_IN2PA_day
FRAG_TP_IN2LIPA_day
FRAG_TP_IN2MVPA_day

Mean duration

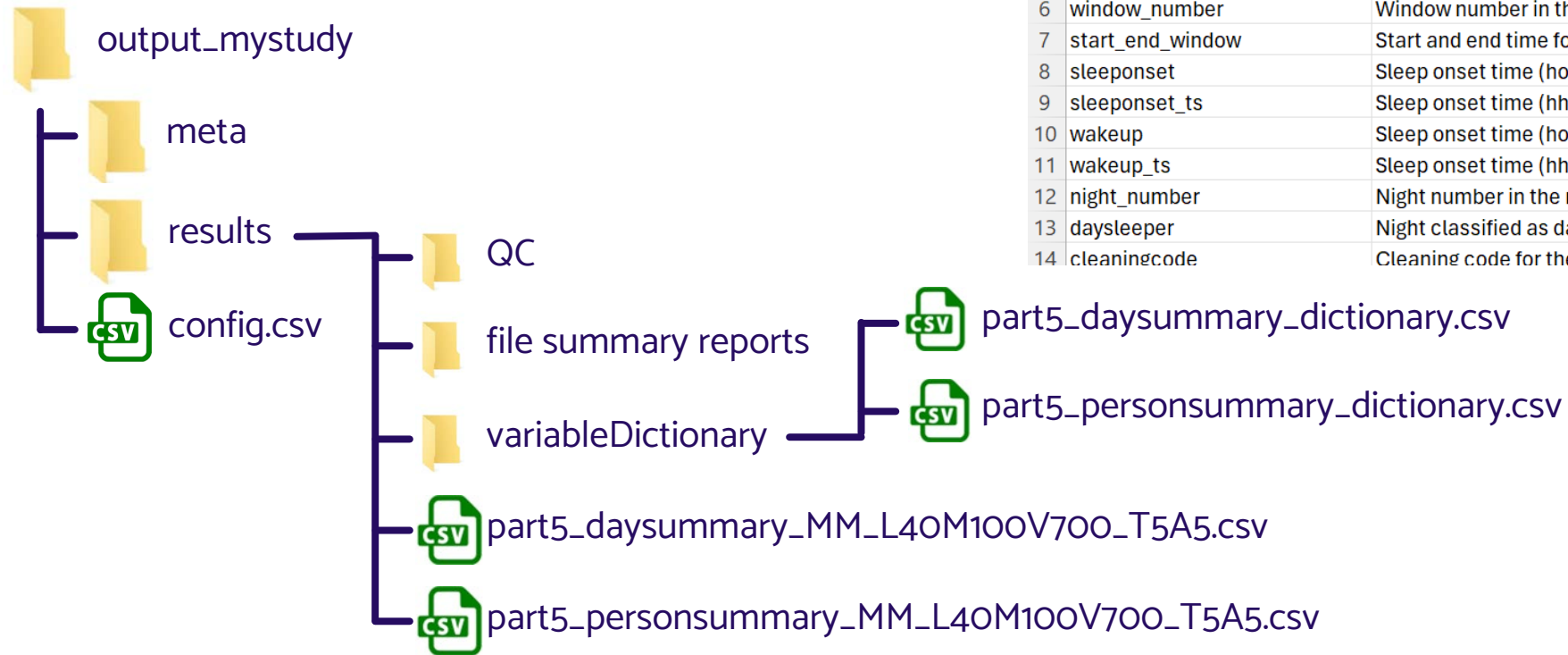
FRAG_mean_dur_IN_day
FRAG_mean_dur_LIPA_day
FRAG_mean_dur_MVPA_day
FRAG_mean_dur_PA_day

Indices

Gini
CoV
Alpha
...

Output from Part 5

Variable Dictionary



	A	
1	Variable	Definition
2	ID	File/participant identifier
3	filename	File name
4	weekday	Day of the week (full name)
5	calendar_date	Calendar date
6	window_number	Window number in the recording
7	start_end_window	Start and end time for the window (hh:mm:ss-hh:mm:ss)
8	sleeponset	Sleep onset time (hours from previous midnight)
9	sleeponset_ts	Sleep onset time (hh:mm:ss)
10	wakeup	Sleep onset time (hours from previous midnight)
11	wakeup_ts	Sleep onset time (hh:mm:ss)
12	night_number	Night number in the recording
13	daysleeper	Night classified as daysleeper (i.e., wake-up time after noon)
14	cleaningcode	Cleaning code for the sleep period time classification (0=no problem)

Output from Part 5





Epoch-level features

```
save_ms5rawlevels = TRUE      # default = FALSE!!  
save_ms5raw_format = "csv"   # default = "RData"  
save_ms5raw_without_invalid = FALSE  
                             # default = TRUE
```

↑

« meta » ms5.outraw » 20_70_260

^

<input type="checkbox"/>	Name	Status
<input checked="" type="checkbox"/>	 100019037_T5A5.csv	
	 100023983_T5A5.csv	

Output from Part 5

Epoch-level features

`save_ms5rawlevels = TRUE` *# default*

`save_ms5raw_format = "csv"` *# default*

`save_ms5raw_without_invalid = FALSE`
default = TRUE

↑ « meta » ms5.outraw » 20_70_260

File explorer showing a list of files:

- ☐ Name
- ☒ 100019037_T5A5.csv
- ☐ 100023983_T5A5.csv

A	B	C	D	E	F	G	H	I	J
timenum	ACC	SleepPeriodTime	invalidepoch	guider	window	class_id	invalid_fullwindow	invalid_sleepperiod	invalid_wakinghours
1404972060	0	1	1	2	13	0	25.76	14.54	51.09
1404972120	0	1	1	2	13	0	25.76	14.54	51.09
1404972180	0	1	1	2	13	0	25.76	14.54	51.09
1404972240	0	1	1	2	13	0	25.76	14.54	51.09
1404972300	0	1	1	2	13	0	25.76	14.54	51.09
1404972360	0	1	1	2	13	0	25.76	14.54	51.09
1404972420	0	1	1	2	13	0	25.76	14.54	51.09
1404972480	0	1	1	2	13	0	25.76	14.54	51.09
1404972540	0	1	1	2	13	0	25.76	14.54	51.09
1404972600	0	1	0	2	13	0	25.76	14.54	51.09
1404972660	19.3	1	0	2	13	0	25.76	14.54	51.09
1404972720	8.492	1	0	2	13	0	25.76	14.54	51.09
1404972780	24.933	1	0	2	13	0	25.76	14.54	51.09
1404972840	26.1	0	0	2	13	13	55.65	77.99	0
1404972900	29.658	0	0	2	13	13	55.65	77.99	0

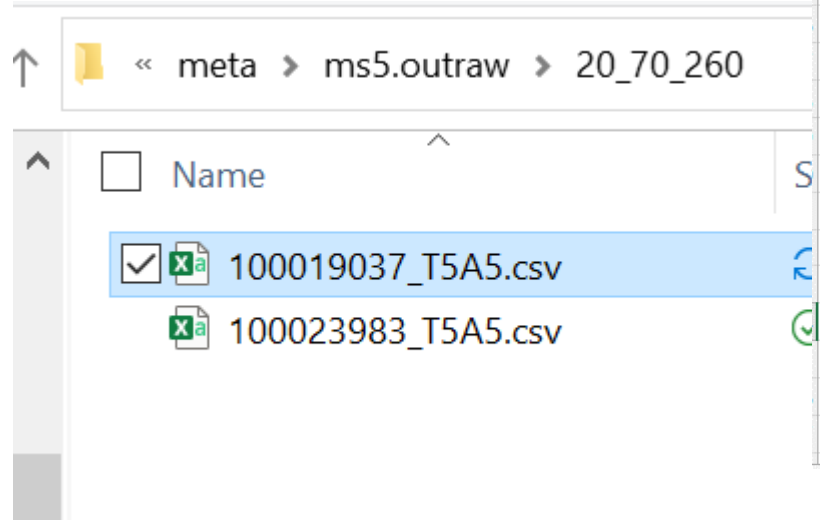
Output from Part 5

Epoch-level features

`save_ms5rawlevels = TRUE` *# default*

`save_ms5raw_format = "csv"` *# default*

`save_ms5raw_without_invalid = TRUE`
default = TRUE

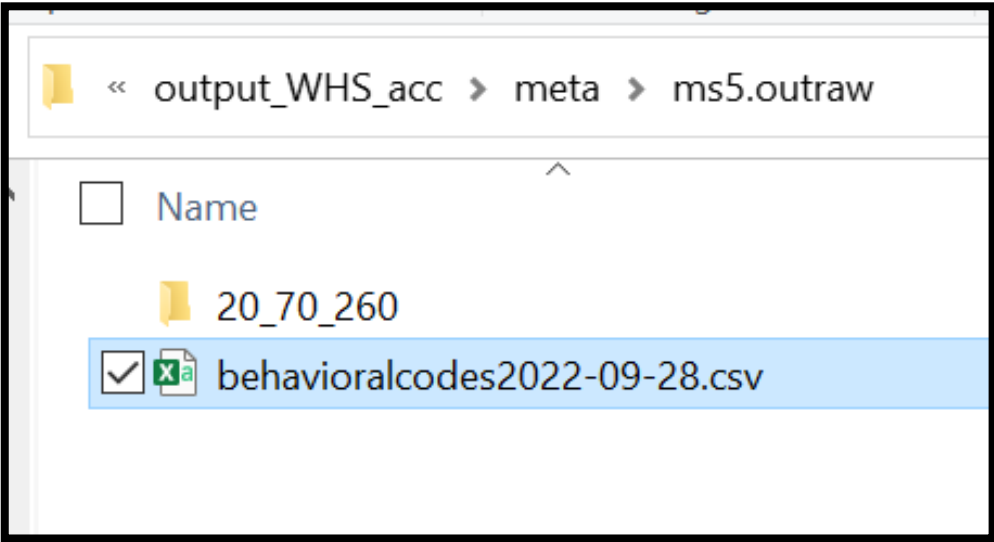


A	B	C	D	E	F	G	H	I	J
timenum	ACC	SleepPeriodTime	invalidepoch	guider	window	class_id	invalid_fullwindow	invalid_sleepperiod	invalid_wakinghours
1404972060	0	1	1	2	13	0	25.76	14.54	51.09
1404972120	0	1	1	2	13	0	25.76	14.54	51.09
1404972180	0	1	1	2	13	0	25.76	14.54	51.09
1404972240	0	1	1	2	13	0	25.76	14.54	51.09
1404972300	0	1	1	2	13	0	25.76	14.54	51.09
1404972360	0	1	1	2	13	0	25.76	14.54	51.09
1404972420	0	1	1	2	13	0	25.76	14.54	51.09
1404972480	0	1	1	2	13	0	25.76	14.54	51.09
1404972540	0	1	1	2	13	0	25.76	14.54	51.09
1404972600	0	1	0	2	13	0	25.76	14.54	51.09
1404972660	19.3	1	0	2	13	0	25.76	14.54	51.09
1404972720	8.492	1	0	2	13	0	25.76	14.54	51.09
1404972780	24.933	1	0	2	13	0	25.76	14.54	51.09
1404972840	26.1	0	0	2	13	13	55.65	77.99	0
1404972900	29.658	0	0	2	13	13	55.65	77.99	0

Output from Part 5

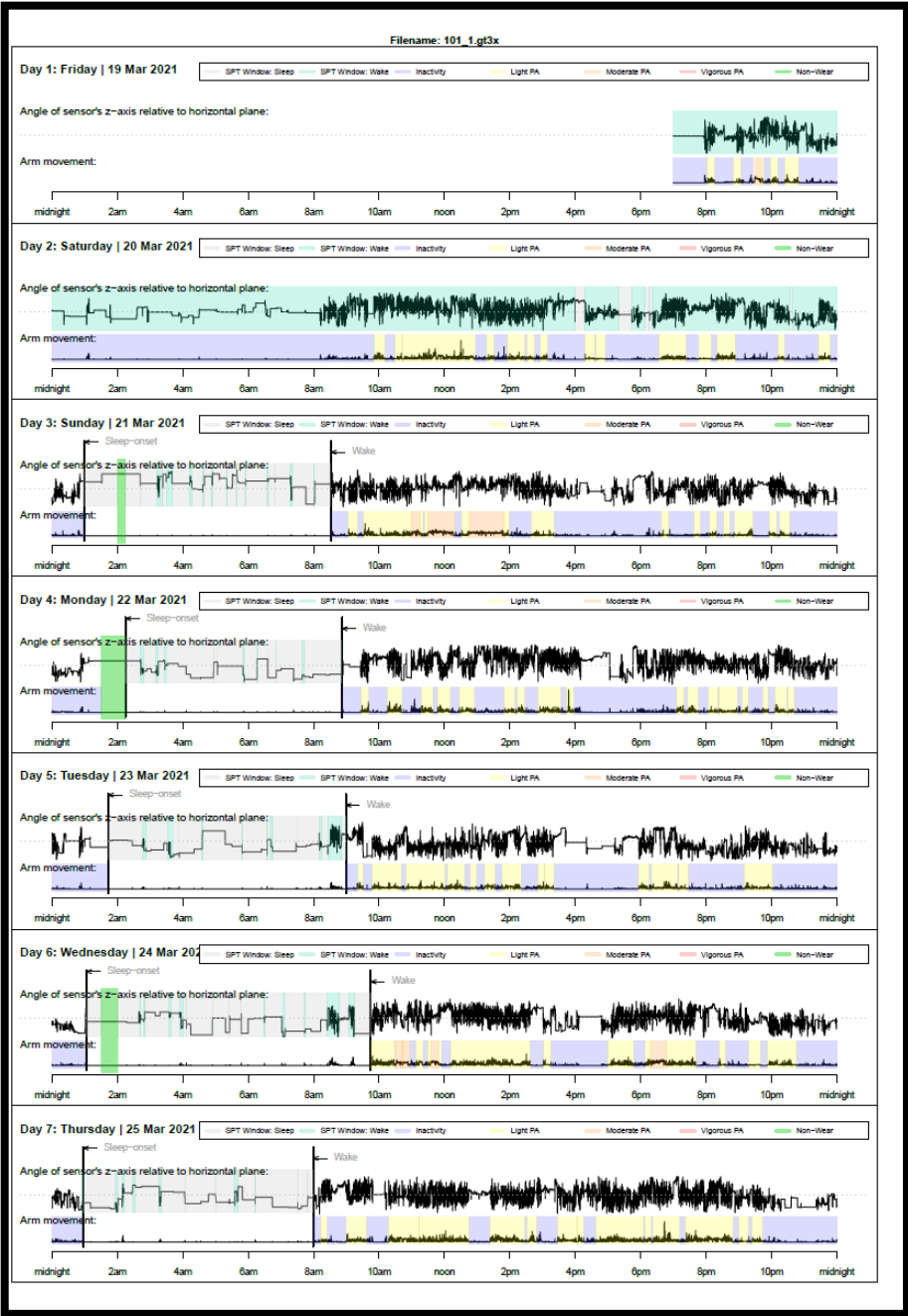
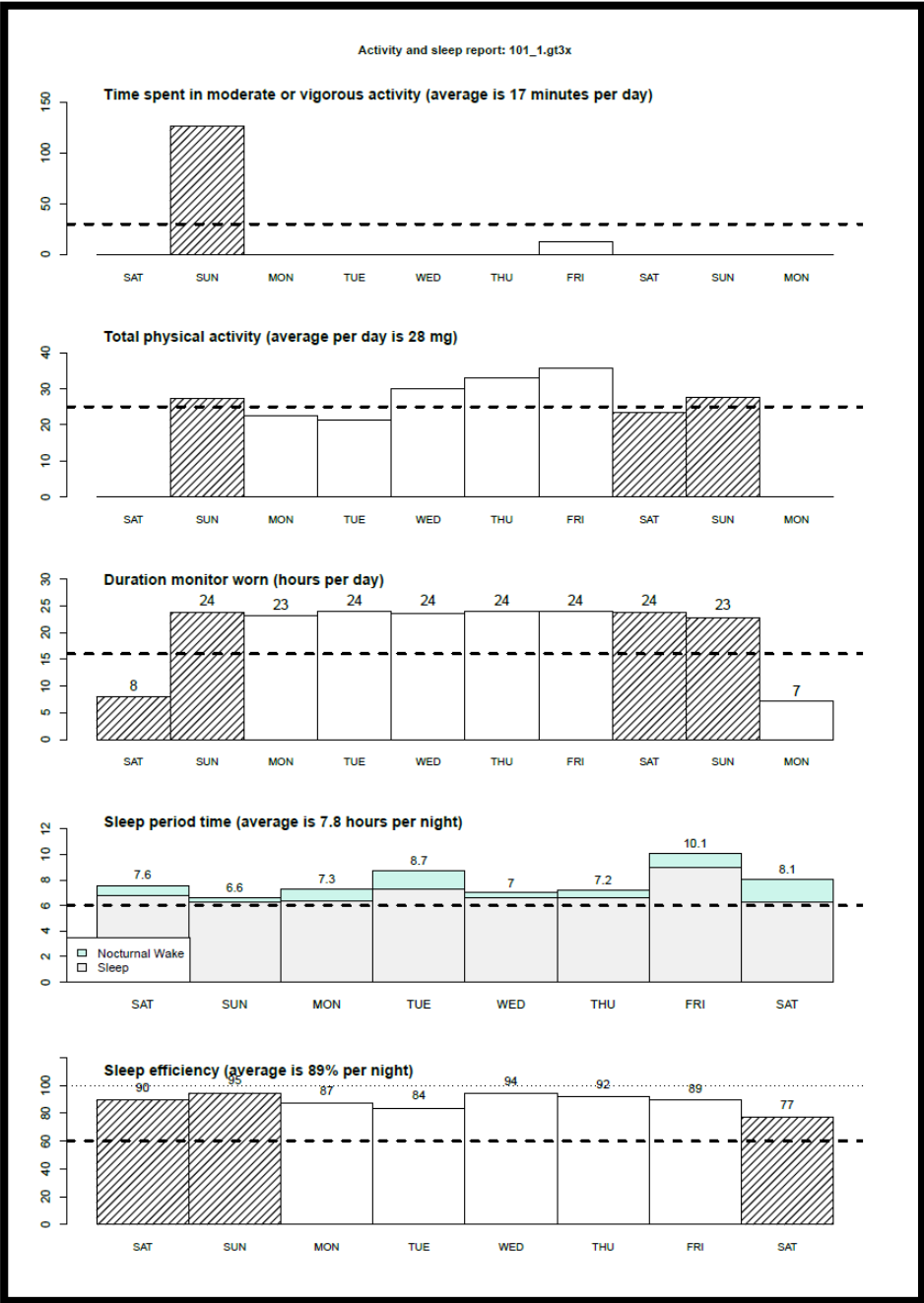
Epoch-level features

```
save_ms5rawlevels = TRUE      # default = FALSE!!  
save_ms5raw_format = "csv"    # default = "RData"  
save_ms5raw_without_invalid = TRUE
```



behavioralcodes_YYYY-MM-DD.csv

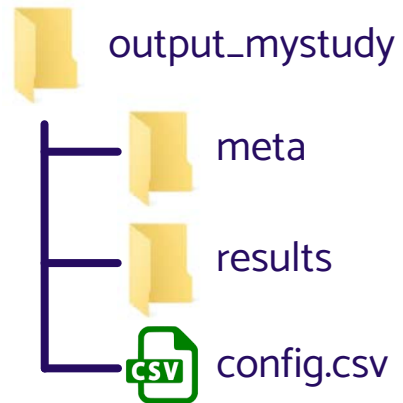
A	B	
class_name	class_id	
spt_sleep	0	
spt_wake_IN	1	
spt_wake_LIG	2	
spt_wake_MOD	3	
spt_wake_VIG	4	
day_IN_unbt	5	
day_LIG_unbt	6	
day_MOD_unbt	7	
day_VIG_unbt	8	
day_MVPA_bts_10	9	
day_MVPA_bts_5_10	10	
day_IN_bts_60	11	
day_IN_bts_30_60	12	
day_LIG_bts_30	13	
day_LIG_bts_10_30	14	



GGIR config file



The GGIR pipeline (output folder)



config.csv file

- Modifiable csv file
- Define arguments used
- Can be called in GGIR to process new files

config			
	argument	value	context
1	config_file_in_outputdir	C:/Users/Jairo/Dropbox/output/output_files/config.csv	not applicable
2	datadir	C:/Users/Jairo/Dropbox/files	not applicable
3	do.report	c(2,4,5)	not applicable
4	f0	1	not applicable
5	f1	2	not applicable
6	mode	c(1,2)	not applicable
7	outputdir	C:/Users/Jairo/Dropbox/output	not applicable
8	studyname	c()	not applicable
9	GGIRread_version	0.2.4	not applicable
10	GGIRversion	2.8.2	not applicable
11	R_version	R version 4.2.1 (2022-06-23 ucrt)	not applicable
12	qwindow	c(0,24)	params_247
13	qllevels	c(0.916666666666667,0.958333333333333)	params_247
14	qwindow_dateformat	%d-%m-%Y	params_247
15	ilevels	c()	params_247
16	IVIS_windowsize_minutes	60	params_247
17	IVIS_epochsize_seconds	c()	params_247
18	IVIS.activity.metric	2	params_247
19	IVIS_acc_threshold	20	params_247
20	qM5L5	c()	params_247

config.csv file

Processing with config file

GGIR(

Processing with config file

`datadir` = "C:/mystudy/files/",

`outputdir` = "C:/mystudy/",



`configfile` = "C:/mystudy/output_mystudy/config.csv")

Which parameter value is used?

Parameter specified in R script?	Config.csv available in output folder?	What is used?
NO	NO	Default parameter values as clarified in documentation
YES	NO	Value as specified in R script
YES	YES	Value as specified in R script
NO	YES	Value in config.csv file

How would GGIR define **threshold.mod**?

```
GGIR(  
  # general settings  
  datadir = "C:/mystudy/mydata",  
  outputdir = "D:/myoutput"  
)
```

  wadpac.github.io/GGIR/articles/GGIRParameters.html

GGIR 3.1-2 The book ▾ Annexes ▾ Installation Get started News ▾ Contributing Need help?

threshold.mod

Numeric (default = 100). In g.part5: Threshold for moderate physical activity to separate light from moderate. Value can be one number or an vector of multiple numbers, e.g., threshold.mod = c(100, 120). If multiple numbers are entered then analysis will be repeated for each combination of threshold values. Threshold is applied to the first metric in the milestone data, so if you have only specified do.enmo = TRUE then it will be applied to ENMO.

Which parameter value is used?

Parameter specified in R script?	Config.csv available in output folder?	What is used?
NO	NO	Default parameter values as clarified in documentation
YES	NO	Value as specified in R script
YES	YES	Value as specified in R script
NO	YES	Value in config.csv file

How would GGIR define **threshold.mod**?

```
GGIR(  
  # general settings  
  datadir = "C:/mystudy/mydata",  
  outputdir = "D:/myoutput",  
  threshold.mod = 200,  
  overwrite = TRUE  
)
```


Which parameter value is used?

Parameter specified in R script?	Config.csv available in output folder?	What is used?
NO	NO	Default parameter values as clarified in documentation
YES	NO	Value as specified in R script
YES	YES	Value as specified in R script
NO	YES	Value in config.csv file

How would GGIR define **threshold.mod**?

```
GGIR(  
  # general settings  
  datadir = "C:/mystudy/mydata",  
  outputdir = "D:/myoutput",  
  threshold.mod = 200,  
  overwrite = TRUE  
)
```

Need help?



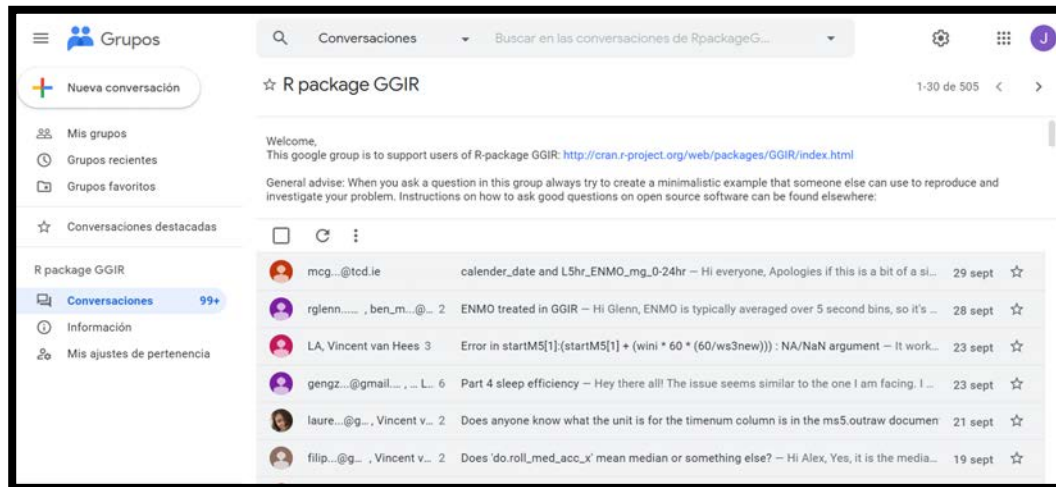
www.accelting.com

Where and How to find help?

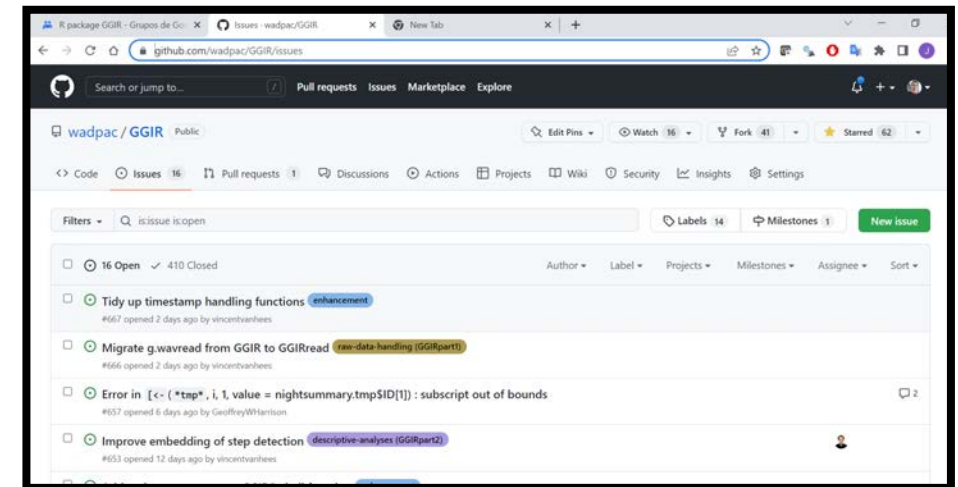
See <https://www.accelting.com/ggir-training-materials/>

- First check documentation
- Try create a reproducible example

<https://groups.google.com/g/RpackageGGIR>

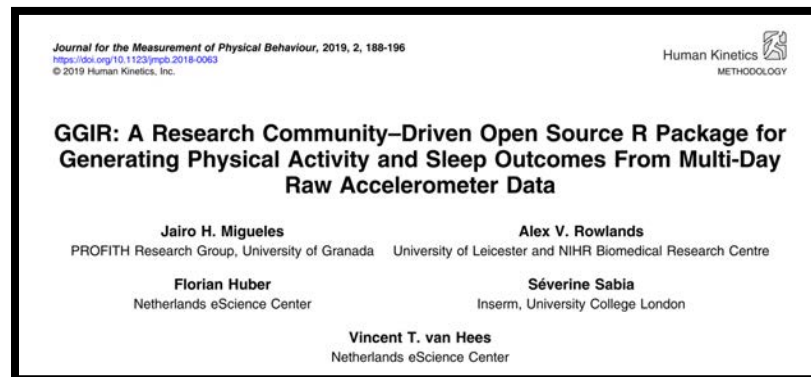


<https://github.com/wadpac/GGIR/issues>



Literature

Where relevant also cited in <https://wadpac.github.io/GGIR/>



Please cite when you use GGIR in your research:
doi: 10.1123/jmpb.2018-0063



Auto-calibration algorithm:
doi: 10.1152/jappphysiol.00421.2014



Sleep algorithm:
doi: 10.1371/journal.pone.0142533

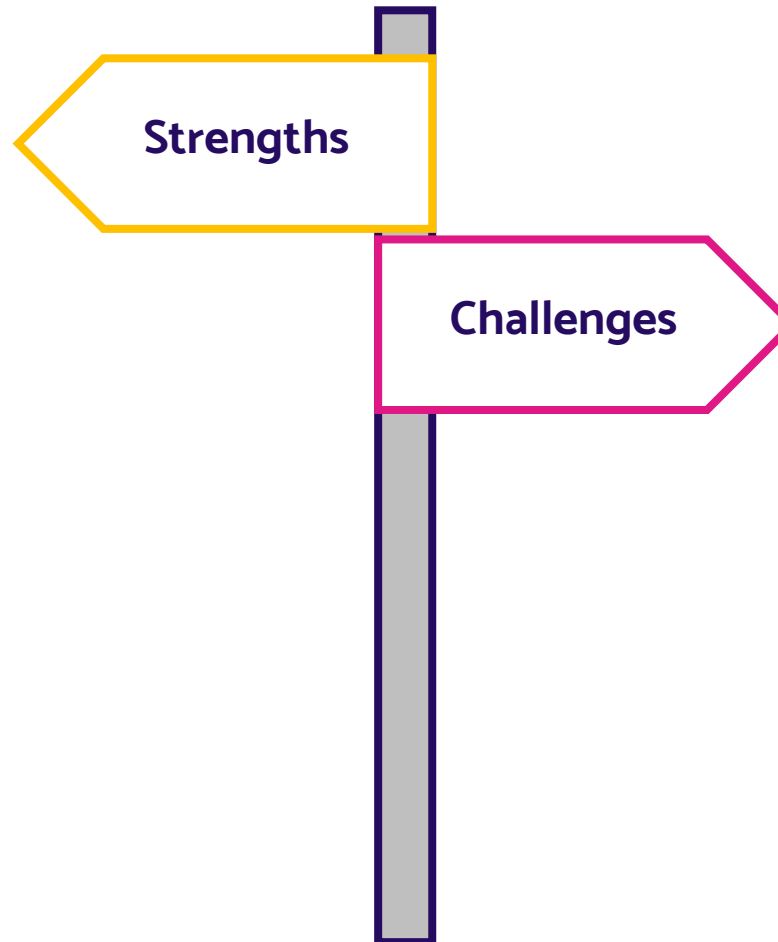
How to contribute



www.accelting.com

Open-Source Software

- Increases reproducibility
- Increases transparency
- Supports community efforts to develop new methods



- Community effort needed

Contribute by...



1. Ask questions / Answer questions
2. Report issues / Help investigate issues
3. Review and help improve documentation
4. Review and help improve code
5. Review and help improve algorithms
6. Cite GGIR in your publications
7. Challenge other researchers to also adopt permissively licensed Open-Source software

Assignment 3 (build on assignment 2)

Preparation:

- Use the same script as in assignment 1 and 2.
- Copy this assignment to your R script and turn it into a comment by adding a # at the start of each line **Hint: A quicker way is to select the lines and press Ctrl+Shift+C**

Task:

- Update your R script to analyse the data with GGIR part 5 for time-use analysis with the following configuration:
 - 1, 2, 5, and 10 min MVPA bouts with a bout criteria of 80% (**hint: use `boutdur.mvpa` and `boutcriter.mvpa`**)
 - 30 and 60 min inactivity bouts with a bout criteria of 95% (**hint: use `boutdur.in` and `boutcriter.in`**)
 - 10-min light physical activity bouts with a bout criteria of 80% (**hint: use `boutdur.lig` and `boutcriter.lig`**)
 - Waking-up to waking-up time window (**hint: use `timewindow`**)
 - Cut-points: 40, 200 and 700 mg ENMO for light, moderate and vigorous (**hint: use `threshold.lig`, `threshold.mod`, `threshold.vig`**)
- Is there a relationship between daytime MVPA with bouts of at least 10 minutes and sleep in the following night?
- Try to understand what the columns in the part 5 csv-output mean.
- Are these cut-points reasonable given published cut-points for children in the literature: <https://wadpac.github.io/GGIR/articles/CutPoints.html>

Day Evaluation

Thank you!

