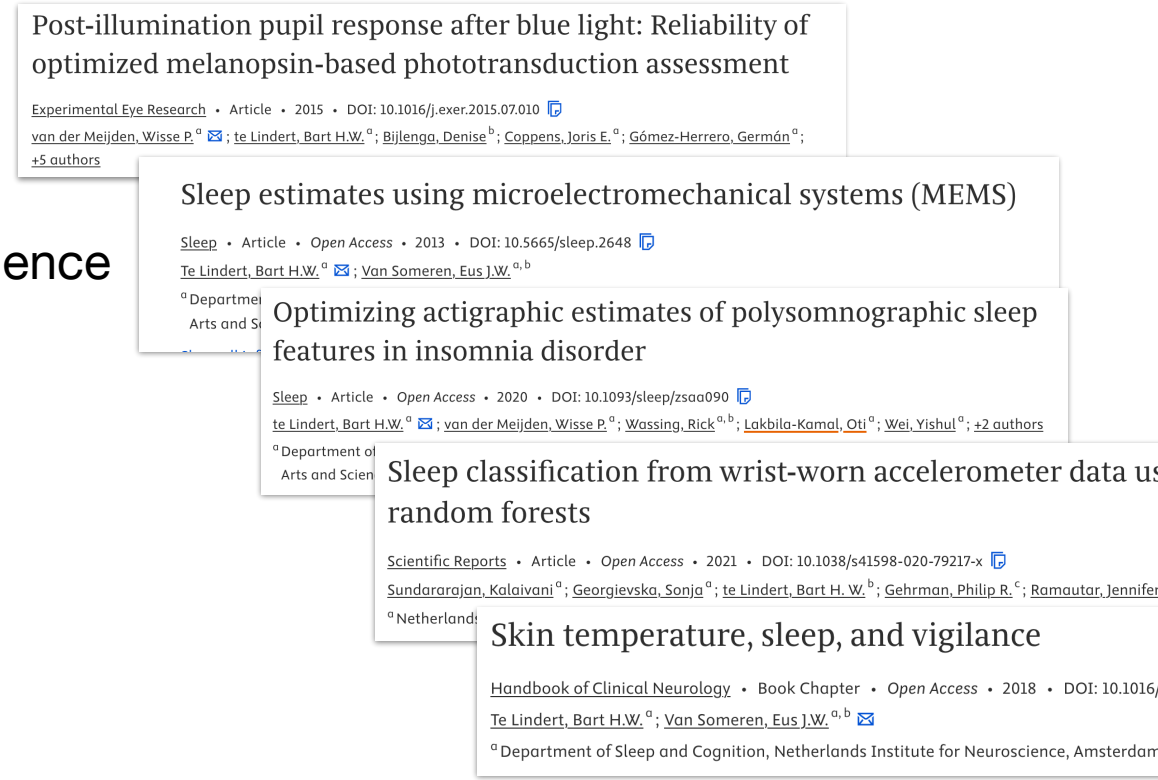
Sleep

(and wake)

Bart te Lindert, PhD

Why me?

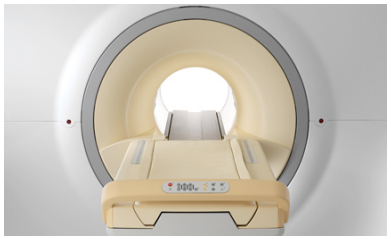
- 9 yrs @ Netherlands Institute for Neuroscience
- full-time fundamental & applied research
- sleep & cognition lab
- insomnia disorder

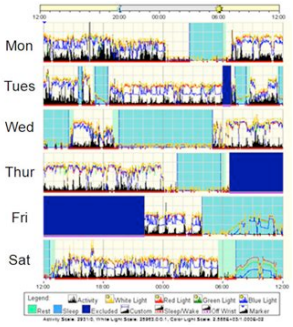


NETHERLANDS INSTITUTE FOR NEUROSCIENCE
Master the mind

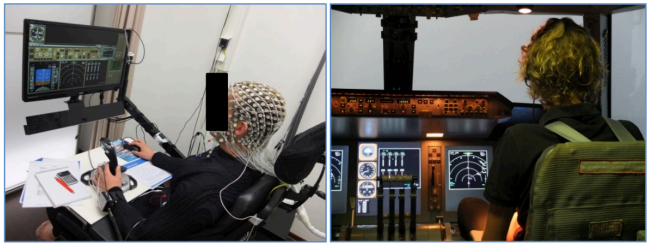
KNAW

How can we look at sleep/wake?





NETHERLANDS SLEEP REGISTRY



Why bother?

- Sleep is a big part of our (child's) life
- Large changes in sleep patterns in early life
- Experts by experience
- Truths, half-truths and misconceptions
- We need to learn/teach good sleep habits
- It helps to know the fundamentals :)

Before the break

- Why do we sleep?
- What are the benefits of sleep?
- What is sleep?
- How is sleep/wake regulated?
- What’s the role of external factors?
- What if the system is disturbed?

After the break

- What if children don’t get enough sleep?
- What is a “normal” amount of sleep?
- What about napping?
- Sleep hygiene
- Summary

Why do we sleep?

Restorative theory: body and mind recover at night

Energy conservation theory: preserve energy during inefficient periods

Adaptive (evolutionary) theory: dark protected against predators and accidents enhancing survival

Brain plasticity theory: re-organise neural connections and brain development

Benefits of sleep

domain	sufficient sleep	insufficient sleep
attention	↑	↓
inhibition	↑	↓
learning	↑	↓
memory	↑	↓
mental/physical health	↑	↓
quality of life	↑	↓

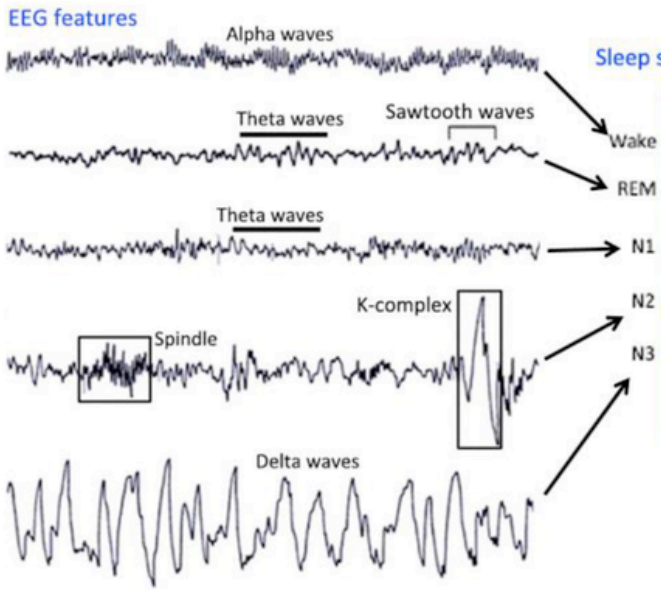
How do we measure sleep?

Polysomnography

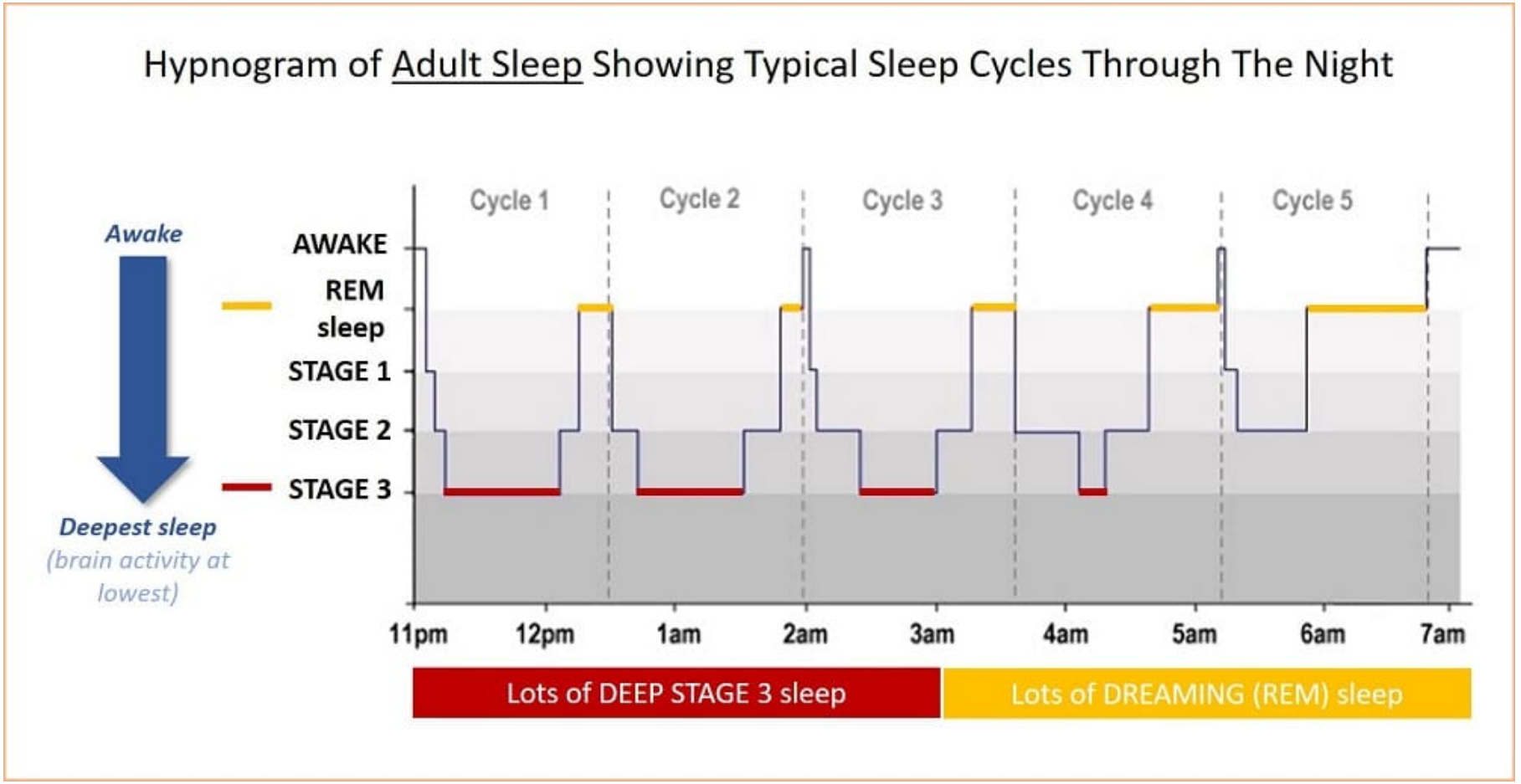
Sleep stages

- N1: light sleep, slow eye movements, jerks, 1-7min
- N2: light sleep, 10-25min
- N3: deep slow-wave sleep, restorative, 20-40min
- REM: rapid-eye-movement sleep, dreaming, 10-60min

A series of sleep stages is a sleep cycle



What are sleep cycles?



How is sleep/wake regulated?

Two-process model of sleep/wake regulation:

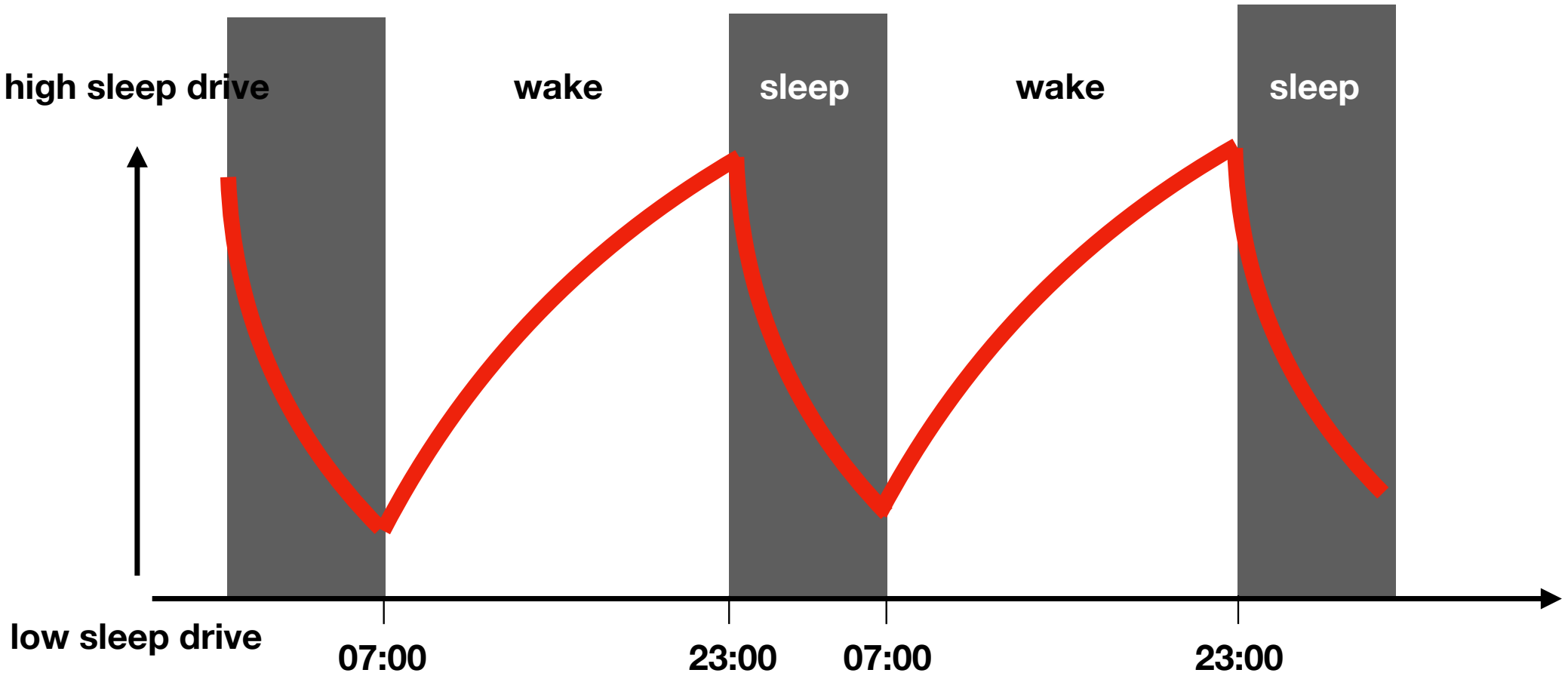
- **S**leep/Wake = process S
- **C**ircadian (or biological **c**lock) = process C

Used to explain effects of: sleep and wake, naps, sleep deprivation, jet lag, shift-work, sleep disorders, chronotype, etc …

What is process sleep/wake (S)?

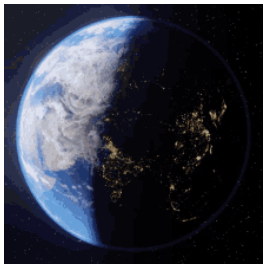
- Hourglass
- Sleep drive *increases* during wakefulness
- Sleep drive *decreases* during sleep
- **S**leep drive = sleep pressure = need for sleep

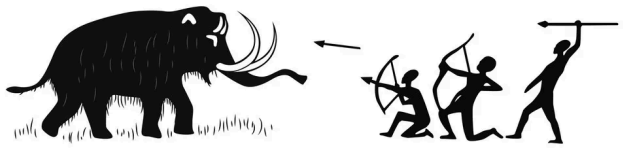
What does process S look like?



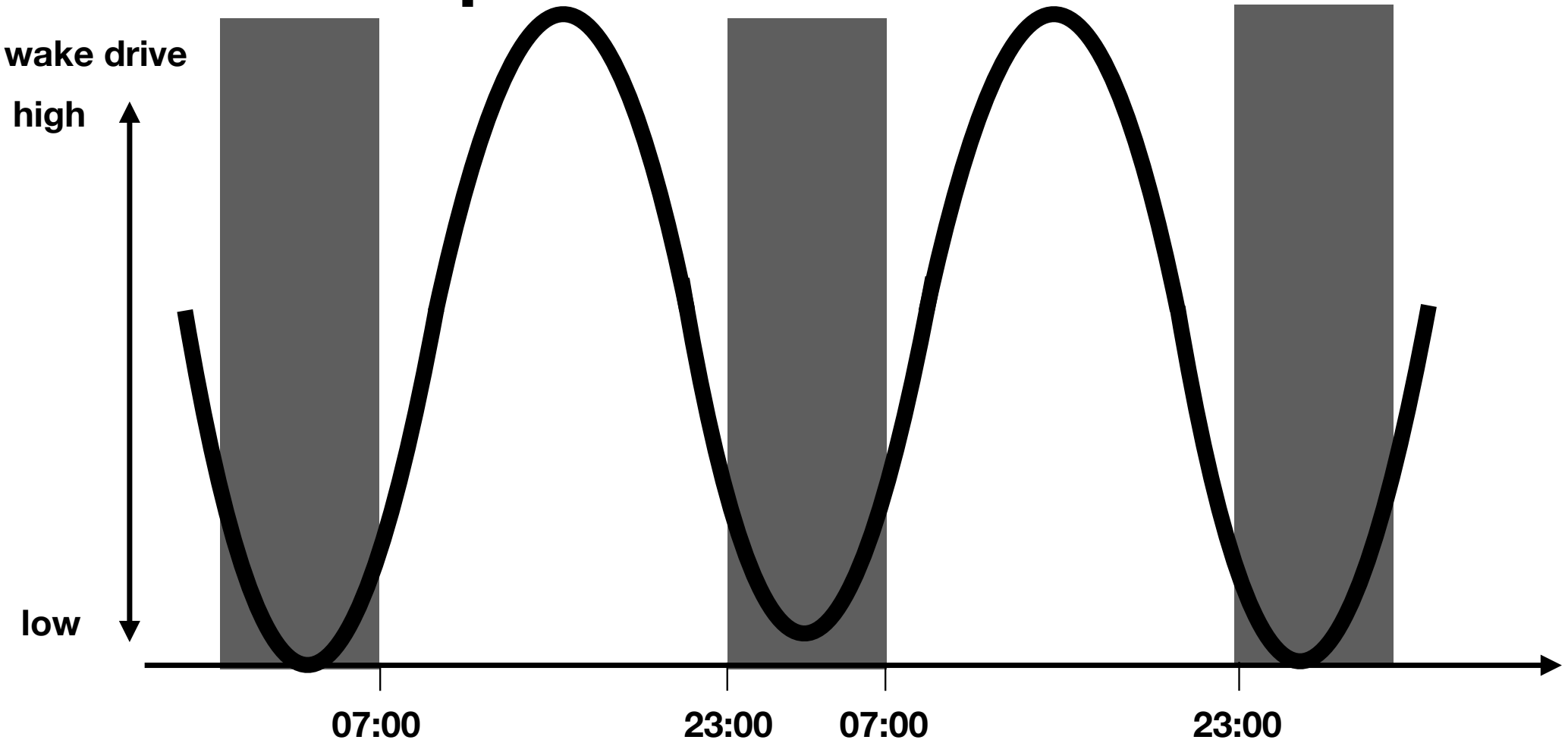
What is process circadian (C)?

- **C**ircadian = around a day
- Biological **C**lock
- Strongly affected by light-dark cycle
- Cyclic wake drive and sleep drive = push to be awake or asleep!





What does process C look like?



What about environmental factors?

day

bright light exposure 

physically active, upright 

food intake 

cognitive activity 

low skin, high core temp 

wake promoting

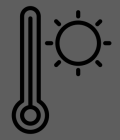
night

 darkness

 physically inactive, supine

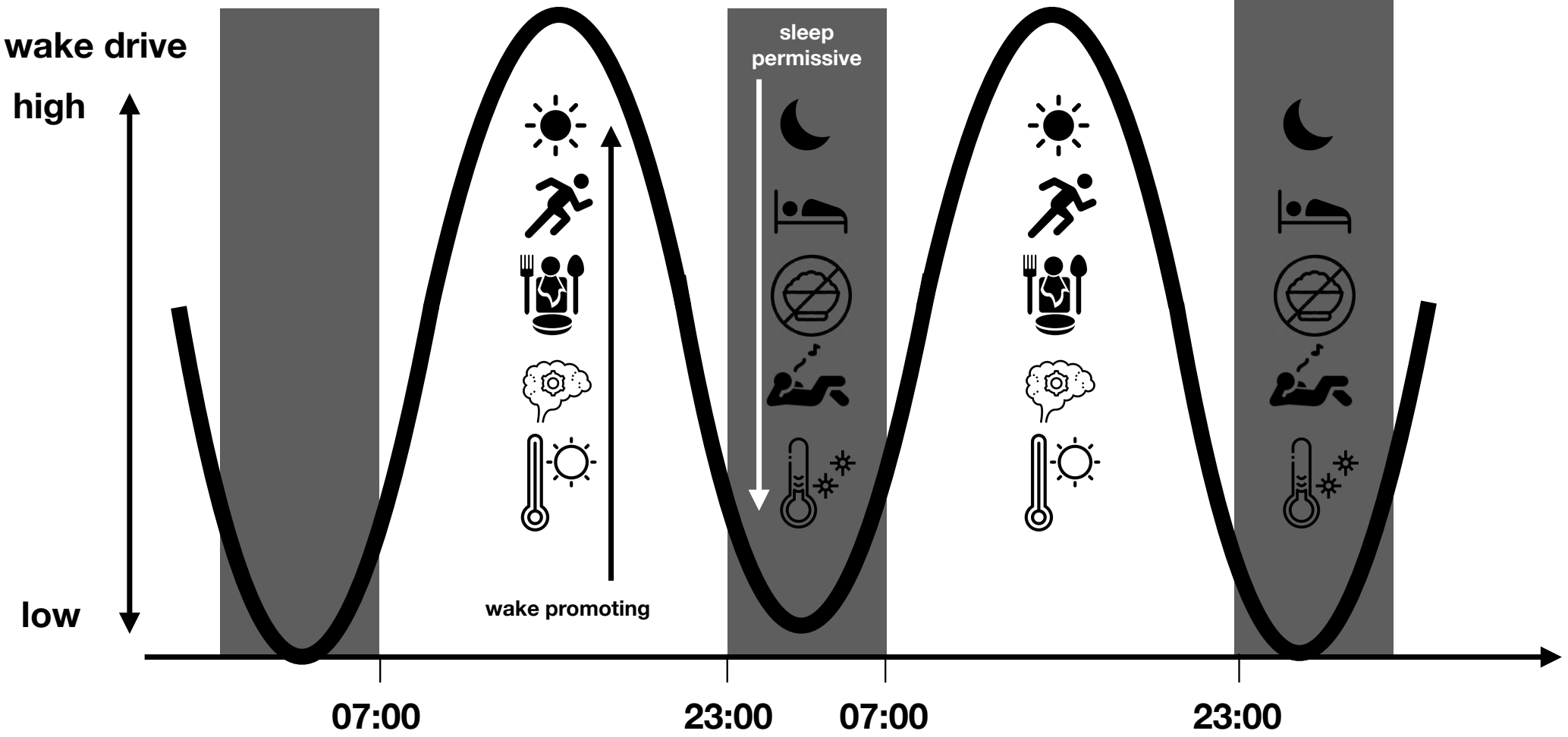
 no food intake

 sleep, safety

 high skin, low core temp

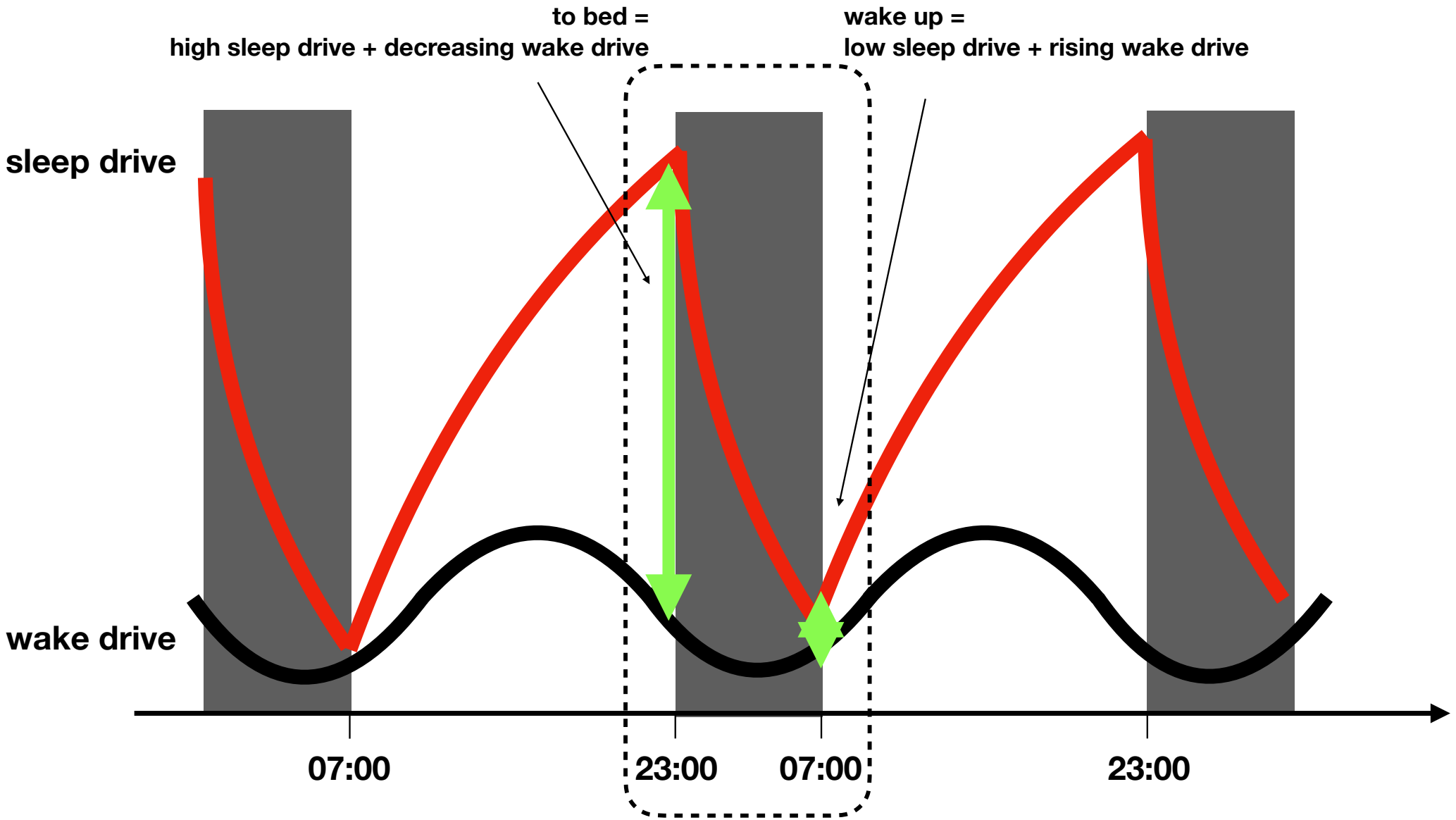
sleep permissive

Time cues and requirements



What happens when S and C align?

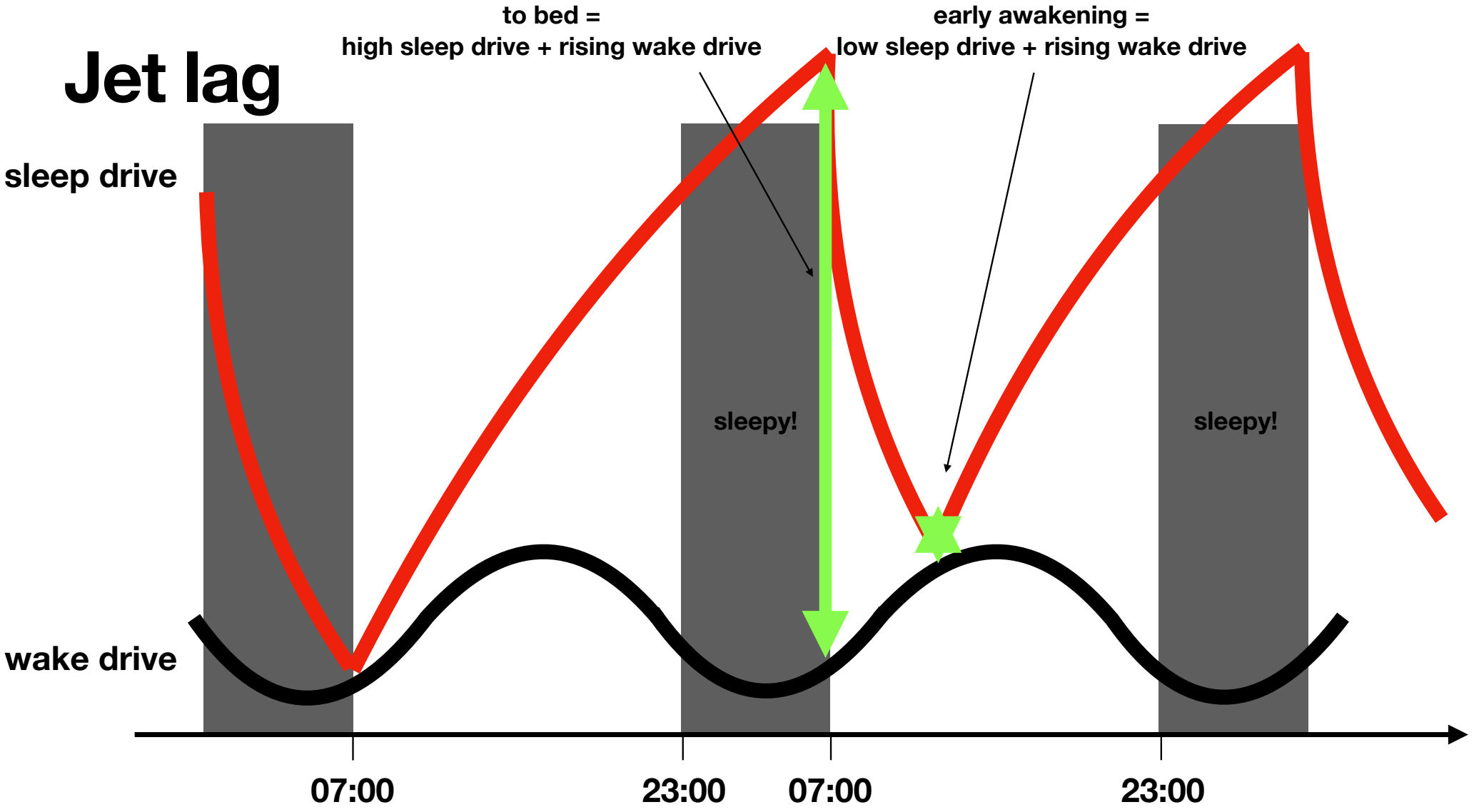
… the good


to bed =
high sleep drive + decreasing wake drive
wake up =
low sleep drive + rising wake drive
sleep drive
wake drive
07:00
23:00
07:00
23:00

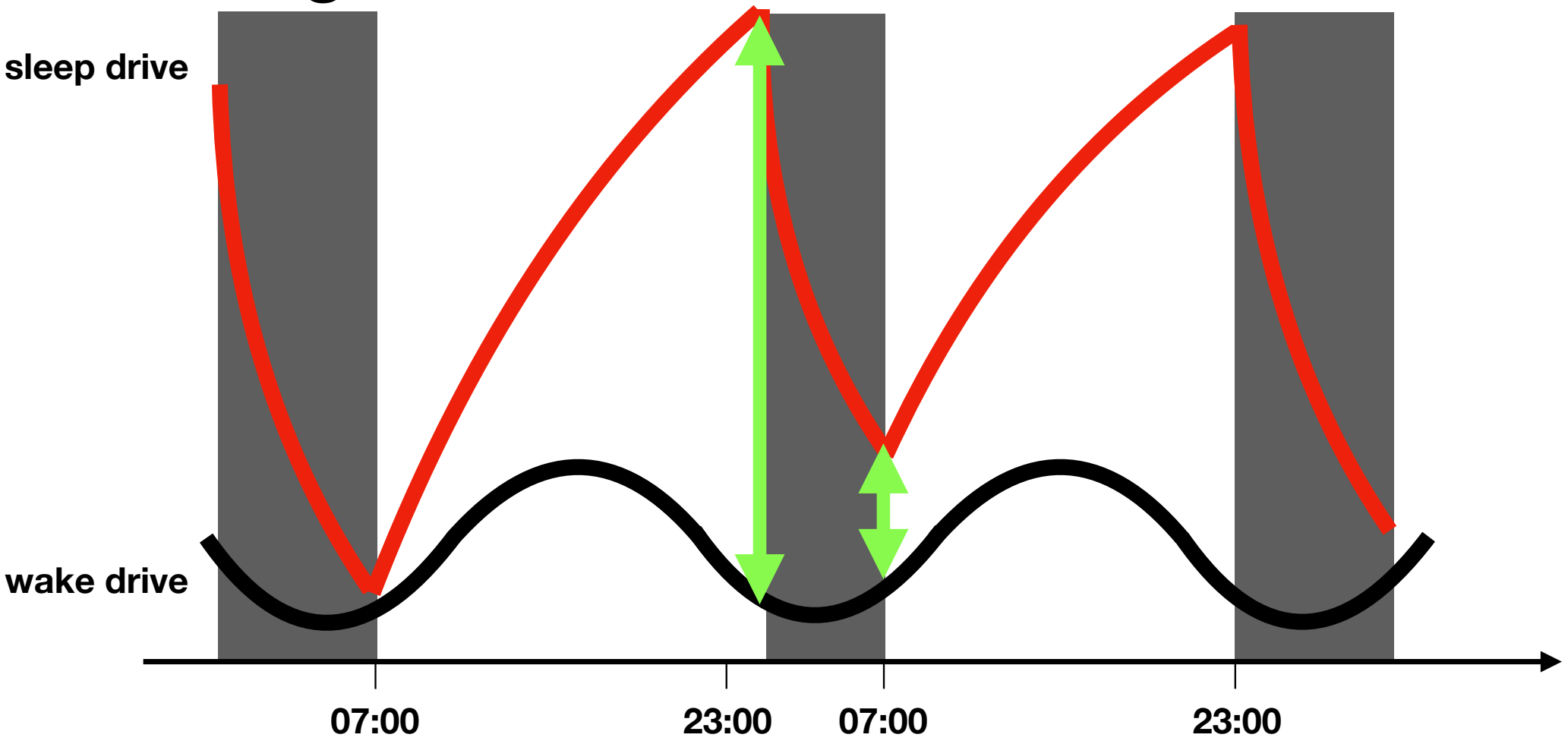
What happens when S and C do not align?

… the bad and the ugly

Jet lag


to bed =
high sleep drive + rising wake drive
early awakening =
low sleep drive + rising wake drive
sleep drive
wake drive
sleepy!
sleepy!
07:00
23:00
07:00
23:00

Late night



Sleeping in a.k.a. social jet lag

Staying up late and sleeping in (weekends)

=> later wake inputs

=> biological clock shifts to your new (later) schedule by 1h/day

=> late Sunday + early Monday = short night

=> higher sleep drive and later wake drive = less alert

=> by Wed you’re re-aligned!

Time for a break!

Effects of sleep

domain	sufficient sleep	insufficient sleep
attention	↑	↓
inhibition	↑	↓
learning	↑	↓
memory	↑	↓
mental/physical health	↑	↓
quality of life	↑	↓

What if they don’t get enough sleep?

- Tantrums and tears
- Low energy
- Impulsivity
- Clinginess
- Tripping
- Sleeping on short rides
- Difficulty falling or staying asleep!

What if they don’t get enough sleep?

- More challenging children need more help
- Might also need more sleep
- Sleep deprivation effects may be worse

What is a “normal” amount of sleep?

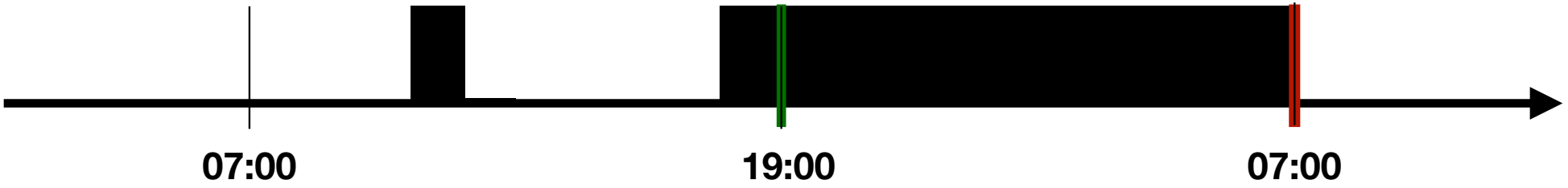
group	age (years)	total hours of sleep	sleep cycle duration (mins)	sleep cycles	nap duration (hours)	night sleep duration (hours)	% stopped napping
mus	1-2	11-14	45-60	2-3	2.3	9-12	<2.5%
røyskatter	2-3	11-14	45-75	2-3	1.9	9-12	33 %
ekorn	3-4	10-13	60-75	1-2	1.7	9-12	57 %
rever	4-5	10-13	60-90	1-2	1.5	9-12	80 % (94 %)

Why do children need the nap?

- Sleep drive builds up faster: *everything* is new!
- Need a nap to recover and consolidate
- They should be rested and calm after a nap
- Part of their 24h sleep need
- Developing towards consolidated night sleep

Naps

- Settle in a fixed schedule
- Set a fixed wake up time
- Choose nap duration/time. Aim for cycles. Wake in light sleep.
- Total sleep - nap = night sleep
- wake up time - night sleep = bed time
- Reducing nap means adding night sleep



Environmental factors

day

bright light exposure 

physically active, upright 

food intake 

cognitive activity 

low skin, high core temp 

wake promoting

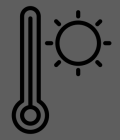
night

 darkness

 physically inactive, supine

 no food intake

 sleep, safety

 high skin, low core temp

sleep permissive

Preparing for sleep?

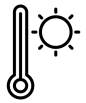
Reduce wake promoting factors

Predictable schedule: fixed bed time, pre-bed routine

Reduce light: no bright outdoors, no screen time, dim lights

Reduce physical activity: no exercise, no play

Reduce mental activity: no gaming, social media or homework



Comfy temperature: shower, no extremes, no stressors

Reduce stimulants: no coffee, energy drinks, heavy meals, soda, chocolate, green tea, alcohol

Improving sleep?

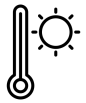
Improve sleep permissive factors

Allow for sufficient sleep time, fixed bed and wake times

Minimal light, darkening curtains

Comfortable bed, supine

No external stimuli; silence, phone muted, safe



Comfortable bedding, room temperature and ventilation

Sufficiently fed and hydrated; no stimulants, food or beverage intake

Summary - prerequisites

- create a safe bedroom
- optimise sleep hygiene
- allow for sufficient sleep
- assist to fall asleep independently

Summary - biological clock

- nail down a sleep schedule
- treat weekends like weekdays
- make bedtime sacred
- adjust naps as needed

Summary - sleep/wake

- make tuck-in relaxing
- reduce wake promoting factors
- increase sleep promoting factors
- be patient :)

Questions?