

SETTING YOUR “CLOCK”

1. Human diurnal rhythm

“owls” and “larks”

contribution of school/work schedules

contribution of “poor” sleep hygiene

can a “lark+owl” marriage work?

Can an “owl” worker survive a “lark” job and vice versa?

Results of in-class survey: N=56

Most people score in the moderate range (31-69 points)

59-69 points N= 6 (11%)

42-48 points N= 24 (43%)

31-41 points N= 21 (37%)

Extreme “larks” (70-86 points) N= 0 (0%)

Extreme “owls” (16-30 points) N= 5 (9%)

Know thyself! (know your basic rhythm, choose appropriate

school schedule/work schedule/spouse

Do not fight your basis rhythm if possible...

2. Core Body Temperature

drops about 1 ½ degrees F. during sleep...why?

Lack of activity?

For most Ss, peak body temp occurs mid/late afternoon

11am to 1pm, to 2pm to 4pm

For most Ss, nadir body temp occurs in early am (2am to 4am)

So, BT starts rising in early morning, starts declining in late afternoon

note: many events can cause brief increases/decreases in BT

e.g. exercise, hot/cold showers, etc.

but core BT returns to stable levels quickly (homeothermic)

2. Core Body Temperature (cont.)

Kleitman – a close correlation between CBT & alertness
& performance

note: **mid-afternoon “slump”** occurs (2-4pm) despite high CBT
other circadian factors

sleep onset – while CBT is falling; wake onset – while CBT is rising

3. Physiology and Sleep/Wake Cycles: examples

growth hormone (from ant. pituitary) – first half of sleep cycle

cortisol (from adrenal cortex) – second half of sleep cycle

K⁺ output in urine (low in sleep, higher in wake)

melatonin – increases in early evening, suppressed by light

4. Sleepiness vs. Alertness: A Major Safety Issue

cognitive alertness – peaks during wake, esp. when CBT is high
(except for 2-4pm “slump”)

lowest during 2-6am (e.g. 5-7x increase in single vehicle truck
accidents...even though there are fewer trucks on the road...
plus Bopal, Chernobyl, 3-Mile Island, Exxon Valdez, etc.

e.g. **German study** of night car driving

“**automatic behavior**” of routine tasks in sleep

S unable to anticipate upcoming events

e.g. **Swedish study** of train engineers

65% fell asleep during a 5 hour/212 mile nocturnal run (vs. 13% on
a daytime run)

e.g. students who fall asleep in class while still taking notes

inability to predict one’s own sleepiness, risk of falling asleep

automatic behavior is associated with “**micro sleeps**” and amnesia
for behaviors when awakened (similar to “**parasomnias**”)

sleep deprivation --- increased frequency of automatic behaviors

5. Sleeping on Schedule

for most people, it is possible to stay on a fairly “normal” S/W schedule

e.g. sleep 11pm to 7am

the key is to **get up every morning at the same time**, irrespective of bedtime
avoids a “free-running” rhythm, which is usually to **delay**
should also go to bed at the same time nightly, with a nightly prebed “routine”

note: it seems very easy for some people (and “all” teens, younger adults)
to develop a delayed rhythm...**physiology** vs. **poor sleep hygiene?**

e.g. bedtime Friday – 1am; sleep in Saturday till 10am; bedtime Saturday
3am; sleep in Sunday till noon; bedtime Sunday night – 10pm, but
cannot get to sleep until 2am; staggers out of bed sleep deprived at 7am
on Monday with the “**Monday morning blues**”

note: many people would mistake the difficulty getting to sleep on Sunday
night as being “**sleep onset insomnia**”, which it is **not!**

However, can develop into try insomnia if *S* now starts to become
anxious about not being able to fall asleep at night

note: irregular S/W schedules can --- **internal desynchronization** of body
rhythms (e.g. CBT rhythms and S/W rhythms no longer run together),
may contribute to feelings of **malaise, poor performance**, GI upset, etc.

note: How long you will sleep on night #1 will determine when you fall
asleep on night #2.....is a common misconception!

When you fall asleep on night #2 is determined mostly by what time it
is in your body “clock”, esp. if your **CBT is falling**

If it is falling, it is easier to fall asleep and you will sleep longer.

Which is why, after an “all nighter” it is often impossible to fall
asleep in the morning...but can fall asleep later that night.

5. Sleeping on Schedule (cont.)

Randy Gardner

Went for 11 days without sleep = 264 hours (about **88 hrs sleep deprived**)

Kept awake via exercise, no stimulants

After his final night with no sleep (Sunday night), he fell asleep on Monday morning at 6:12am and slept till Monday night at 8:52pm = **14 hrs 40 min.**

He then stayed awake from Monday night until Tuesday night, about 24 hrs.

He then fell asleep Tuesday night at 8:53pm and slept till 5am on Wednesday, for about **8 hours** sleep, and then kept that rhythm from then on.

6. Light-Dark Cycle

At the **arctic circle** at midwinter there is 24 hrs of darkness

Increased insomnia, depression and suicides (highest in Dec. & Jan.)

Occurs in native peoples as well as emigrants

Living life indoors --- Ss exposed to reduced light levels (vs. outdoors)

Shift workers also are “light deprived”, working under dim light at night, sleeping in dim light during the day

Elderly/hospitalized Ss (especially those that do not go outside) are “light deprived”

Prisoners are “light deprived”, **Miners** are “light deprived”

Swedes are “light deprived”

1 lux = light **intensity** given off by 1 candle at distance of 1 meter

noonday sun = 100k lux

full moonlight night = 0.33 lux

dawn = 10k lux

room lit by incandescent bulbs = 300 lux

very bright room lit by fluorescent bulbs = 2k lux

and there is also the issue of the **wavelength of light** (its spectrum, frequency of wavelength) needed to set clock, synthesize vitamin D, etc.

What are and where are the photoreceptors that respond to L/D?

If remove the eye (in mammals) or sever the optic nerve--- no light entrainment

Thus, conclude that photoreceptors must be **in the eye**...somewhere...

6. Light-Dark Cycle (cont.)

What about birds, lizards, etc? If remove the eye or cut the optic nerve ---

They can still entrain to light...so photoreceptors are **not in the eye**...

What about **“blind” humans** who have no conscious perception of light?

At least some of these people can entrain to light...How?

The visual system: rods & cones, retina, optic nerve formed by the axons of ganglion cells

optic nerve projects back to the thalamus (lateral geniculate body) and then on to the occipital lobes (visual cortex)

in mammals, an “offshoot” pathway splits off of the optic nerve and goes to the **hypothalamus (suprachiasmatic nucleus)**

the SCN sends signals to the pineal gland (to suppress production of **melatonin** from **serotonin** in light; to increase production of melatonin from serotonin in darkness)

melatonin level becomes a major signal for sleep onset/maintenance

what about in non-mammals? Those birds, lizards, frogs, etc.

their pineal gland is stimulated by light directly through their (thin)

skulls find photoreceptors/photopigments mixed into the tissue of the pineal itself.

Getting back to those thick-skulled mammals, the rods, the cones, and their photoreceptors

Rods – **rhodopsin**; cones – **3 photopigment opsins**

But...mice bred to lack either rods, cones, or both...can still entrain to light!

So...there must be another photoreceptor/photopigment besides the 4 we know about now...and it must be in the retina/eye somewhere...

And we now know that it is most sensitive to **479 nanometers** wavelength of light (in the “blind” mice, at least), and that it is an opsin

Humans too (blind or sighted) seem also be entrain best to the **“bluegreen”** wavelengths of light (vs. some flowering plants like the “reds”)