Human cognitive functions with desynchronosis

Mikhail F. Borisenkov, PhD, DSc,
Institute of Physiology, Komi SC UB RAS
borisenkov@physiol.komisc.ru

International Forum “COGNITIVE NEUROSCIENCE – 2018”
Yekaterinburg, 06–08 November 2018

Molecular clock

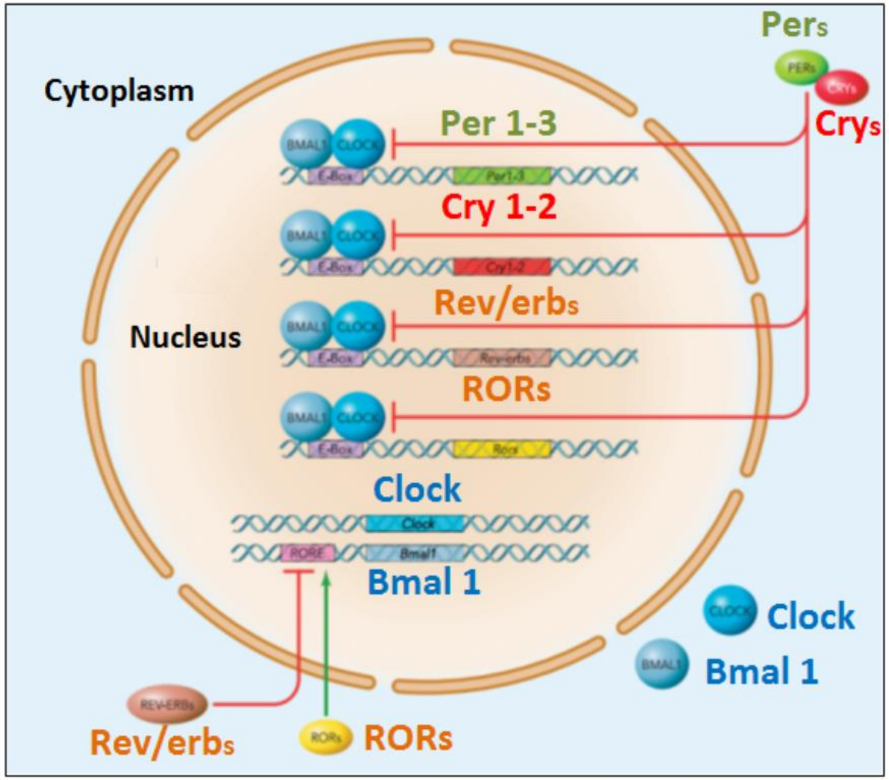
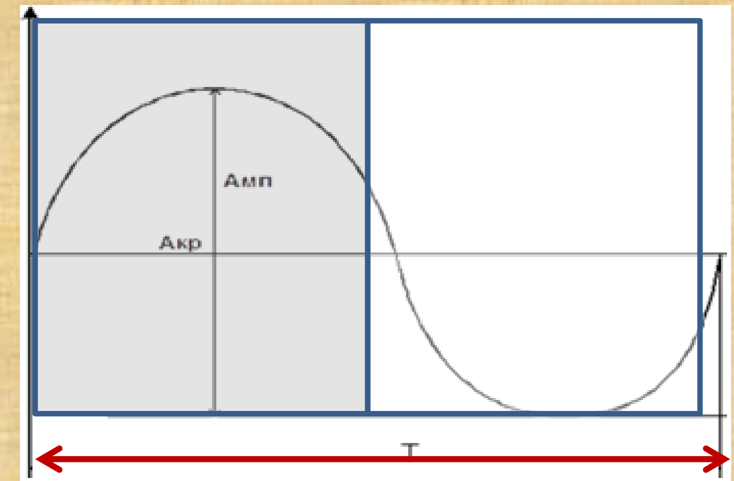


Figure from (Froy, 2011)



tau ≈ 24 h

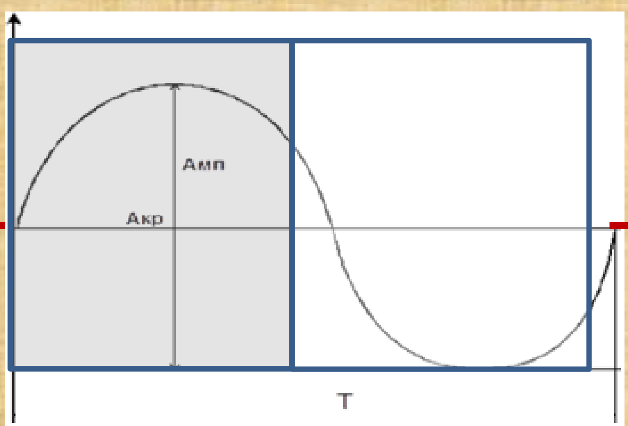
Mean	Range	References
24.2±0.2 h	23.8 – 24.8	Eastman et al., 2015
24.2±0.2 h	24.1 – 24.6	Carskadon et al., 1999

Estradiol
(Morin et al., 1977)

African-American
(Eastman et al., 2015)

Equatorial latitudes
(Leocadio-Miguel et al., 2018)

< *tau*



tau >

Testosterone
(Daan et al., 1975)

High-fat diet
(Kohsaka et al., 2007)

Lithium
(Abe et al., 2000)

Circadian clock system

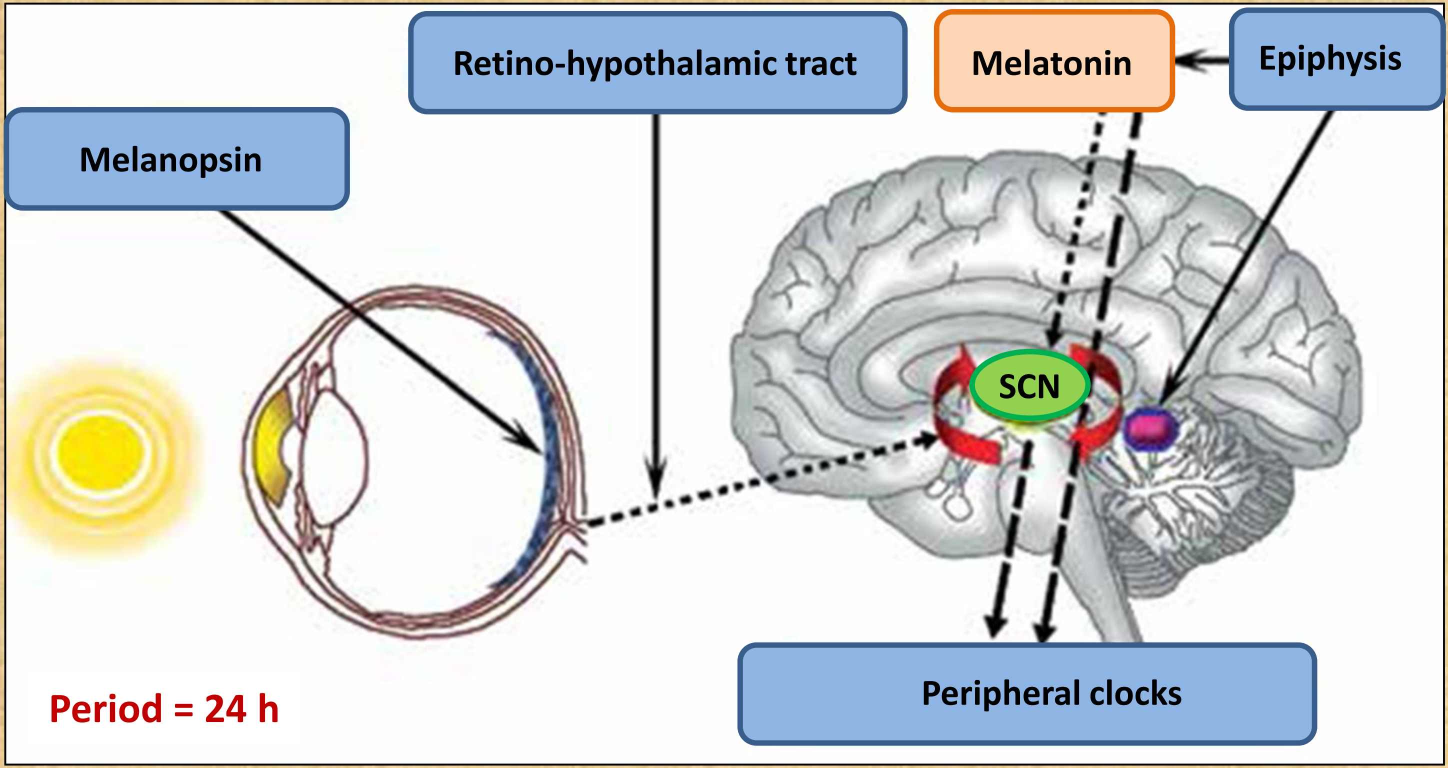
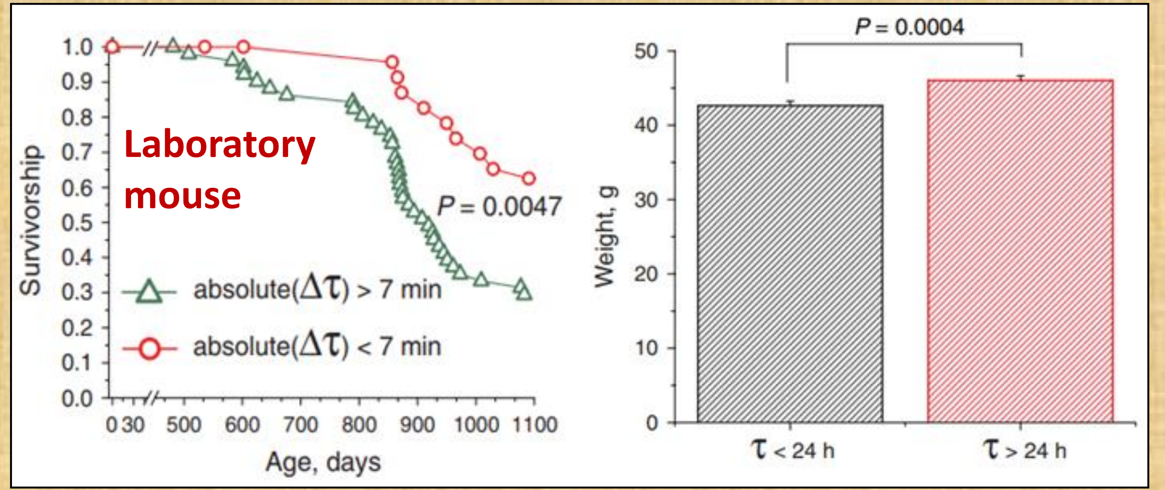


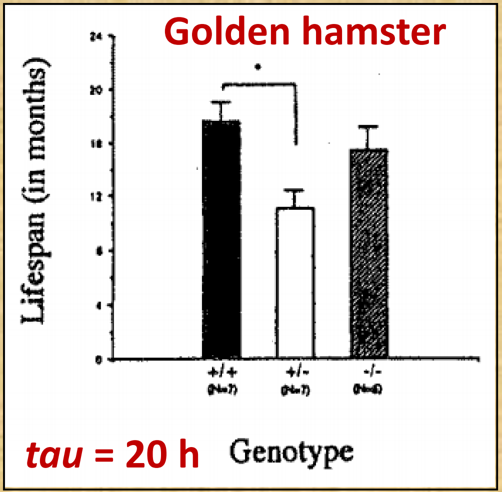
Figure from (Borisenkov, 2013)

Circadian resonance

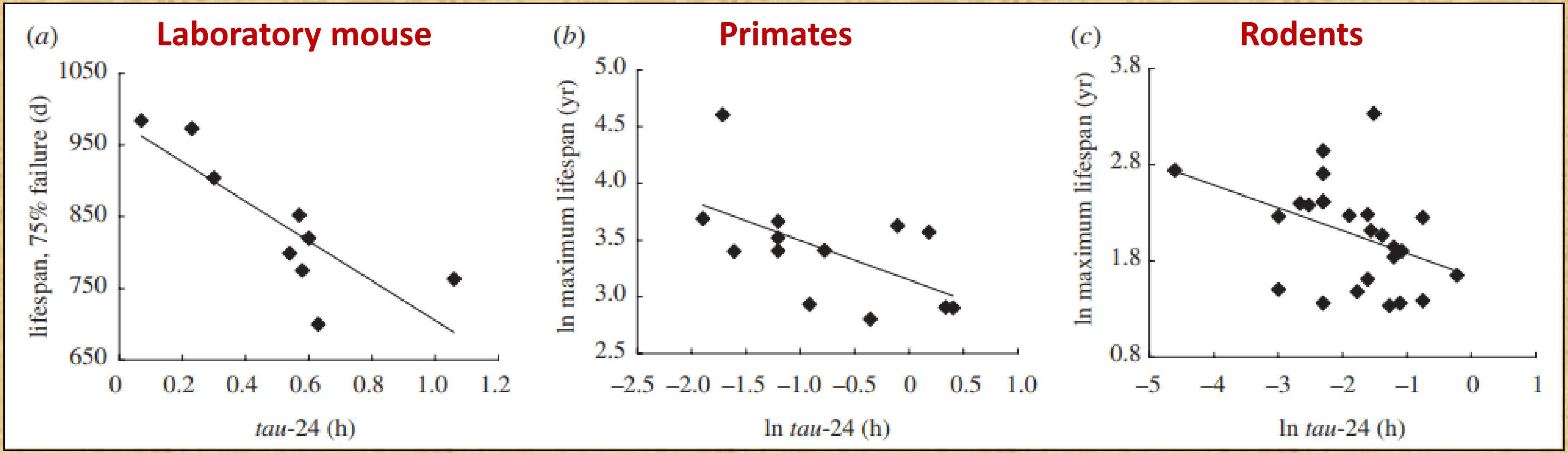
(Pittendrigh, Bruce, 1959)



(Libert et al., 2012)



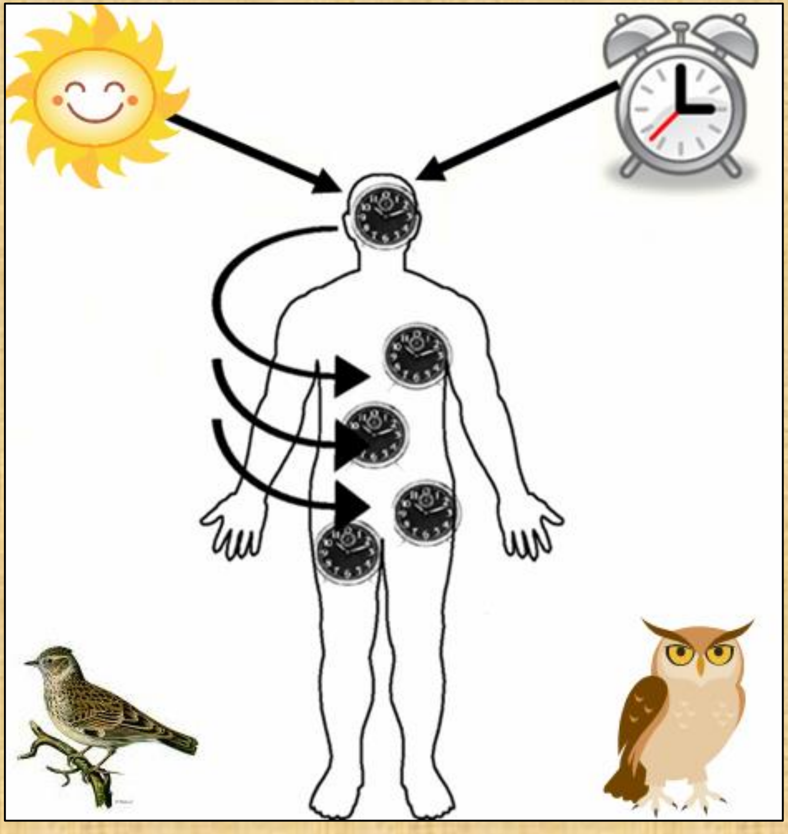
(Hurd, Ralph, 1998)



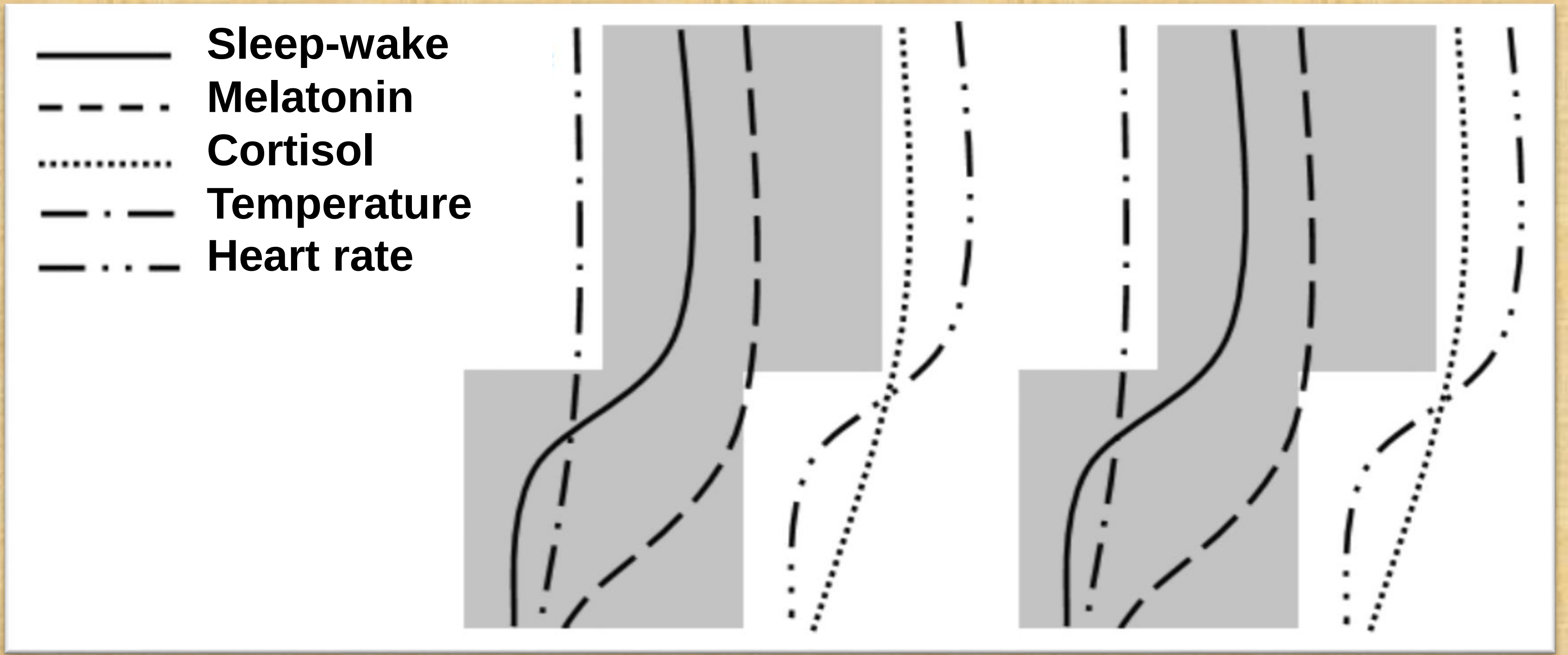
(Wyse et al., 2010)

External desynchrony

1. Trans meridian travels 2 millions.
2. Shift work 15-20% (Bonneford et al., 2004).
3. Living in high latitudes of the Earth 11,5 millions.
4. Social Jetlag 70-86% (Roenneberg et al., 2015; Borisenkov et al., 2017).



Jetlag



Symptoms of jetlag:

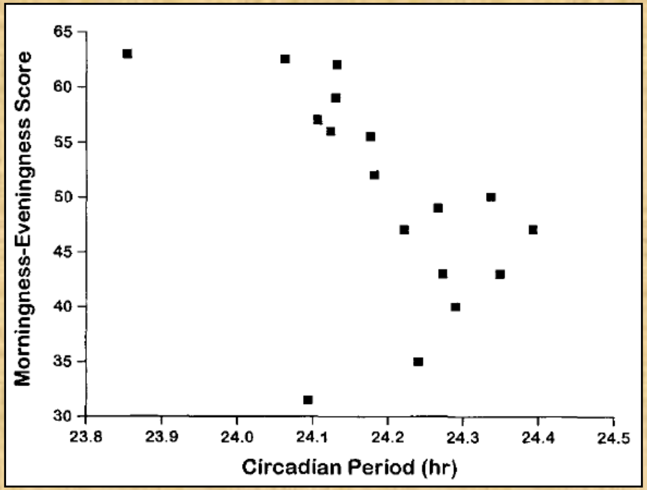
Insomnia
Fatigue
Memory impairment
Depression

Biochemical markers:

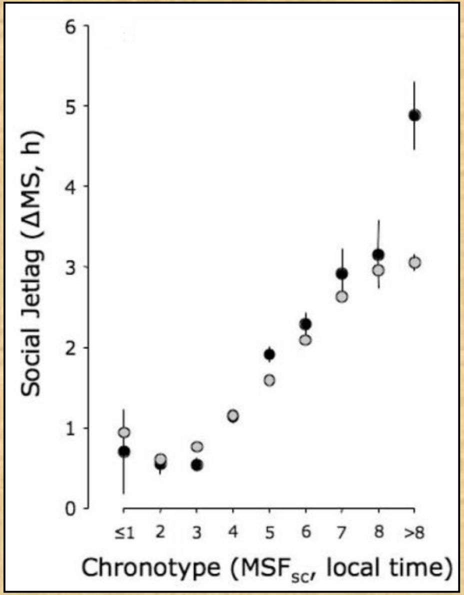
Cortisol ↑
IL-6 ↑
Leptin ↑
Serotonin ↓
Melatonin ↓

Social Jetlag

Till Roenneberg



(Duffy et al., 2001)



(Wittmann et al., 2006)

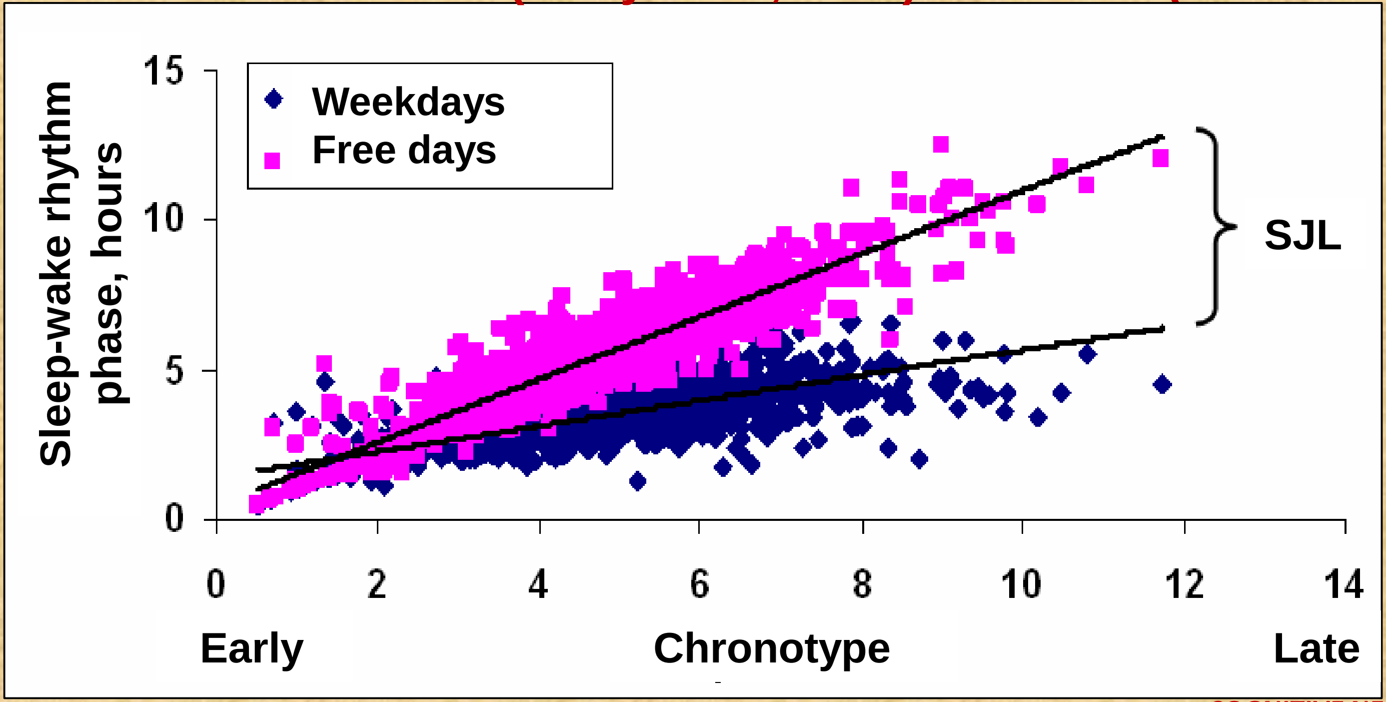
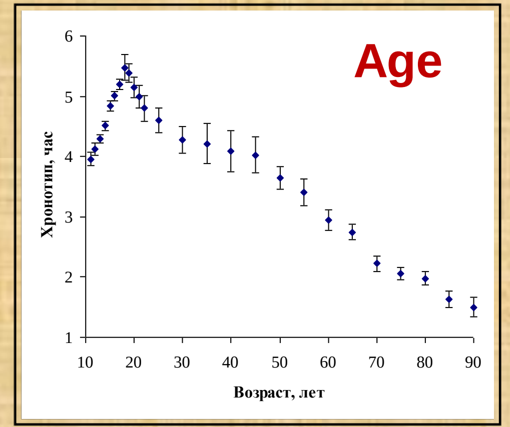
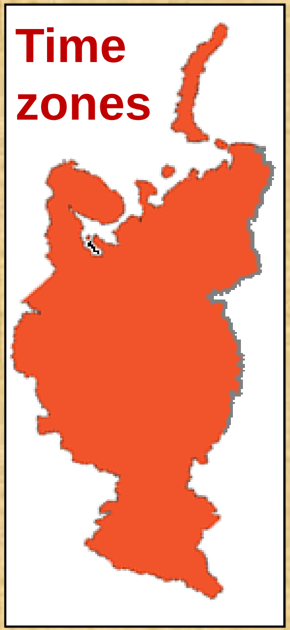
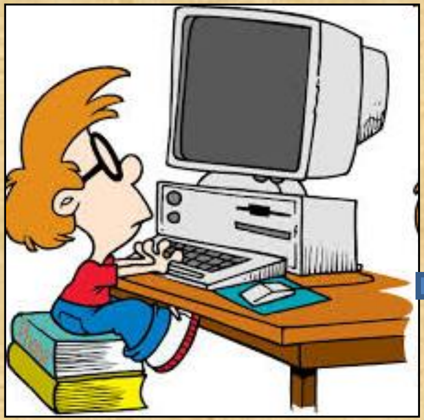


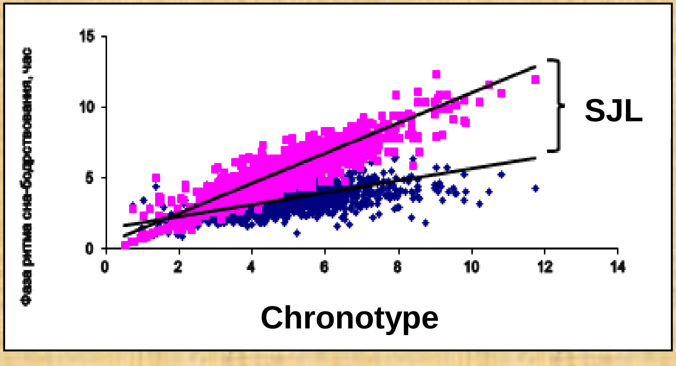
Figure from (Borisenkov, 2012)

External factors increasing social jetlag rate









COGNITIVE NEUROSCIENCE – 2018
Yekaterinburg, **06–08.11.2018**

Permanent ST vs. DST in Europe

24th Congress of the European Sleep Research Society
Basel, Switzerland I 25 – 28 September 2018

Panel Discussion "Daylight Saving Time – Forever?" | ESRS 2018 | Summary

Panel Members: Derk-Jan Dijk, Gilles Vandewalle, Kenneth Wright, Eva Winnebeck

Chair: Christine Blume

Organisers: Manuel Schabus & Christine Blume

2. Direct comparisons of DST vs. ST are limited and inherently confounded by seasonal effects on weather, temperature and daily light exposure. A study by Borisenkov and colleagues (2017), which retrospectively studied effects in children and adolescents in northern Russia (mostly >60° latitude), found that permanent DST compared to ST was associated with a 2-3% increase in the rate of symptoms of winter depression as assessed with the Seasonal Pattern Assessment Questionnaire (Rosen et al., 1990). Further, the amount of social jetlag[1] (SJL) was higher during permanent DST vs. ST. In detail, during perennial DST SJL increased by ≈34 minutes on average (small to medium effect size [r = 0.2], although the clinical significance of this effect may be different), which resulted from get-up times on weekends being delayed by ≈34 minutes, and there was an overall increase from 53 to 70% of the study sample presenting with SJL >2h. The largest decrease in SJL and shift towards earlier get up times on weekends occurred at high latitude near the Arctic Circle during perennial ST compared to DST.

4. Effects of perennial DST vs. ST on biological timing and health
   a. Longitude data (i.e. whether we live in the east or west of a time zone) suggest that a later solar noon is associated with negative effects such as an increase in the relative risk for cancer and decreased life expectancy (Gu et al., 2017; Borisenkov et al., 2011). However, if these findings can be extrapolated to ST-DST, perennial DST would be associated with more negative effects than ST.

Society for Research on Biological Rhythms

Dear Representative,

As experts in biological clocks and sleep, we have been following the initiatives of the European Commission and California Proposition 7 to abandon the annual clock-time changes in spring and autumn. Although we recognize that there are advantages/disadvantages associated with any choice, we emphasize that the scientific evidence presently available indicates that installing perennial Standard Time (ST, or 'wintertime') is the best and safest option for public health. The negative effects of maintaining Daylight Saving Time (DST) will be higher.

With ST there will be more morning light exposure in winter and less evening light exposure in summer. This will better synchronise the biological clock and people will sleep earlier relative to their work and school times. The feeling of chronic 'Social Jetlag' will be reduced compared to DST, the body will function better, psychological well-being and mental performance will improve. Throughout the year, ST will be healthier than DST in terms of sleep, cardiac function, weight, cancer risk, and alcohol- and tobacco consumption, to name a few examples.

We would gladly explain our advice in more detail as required.

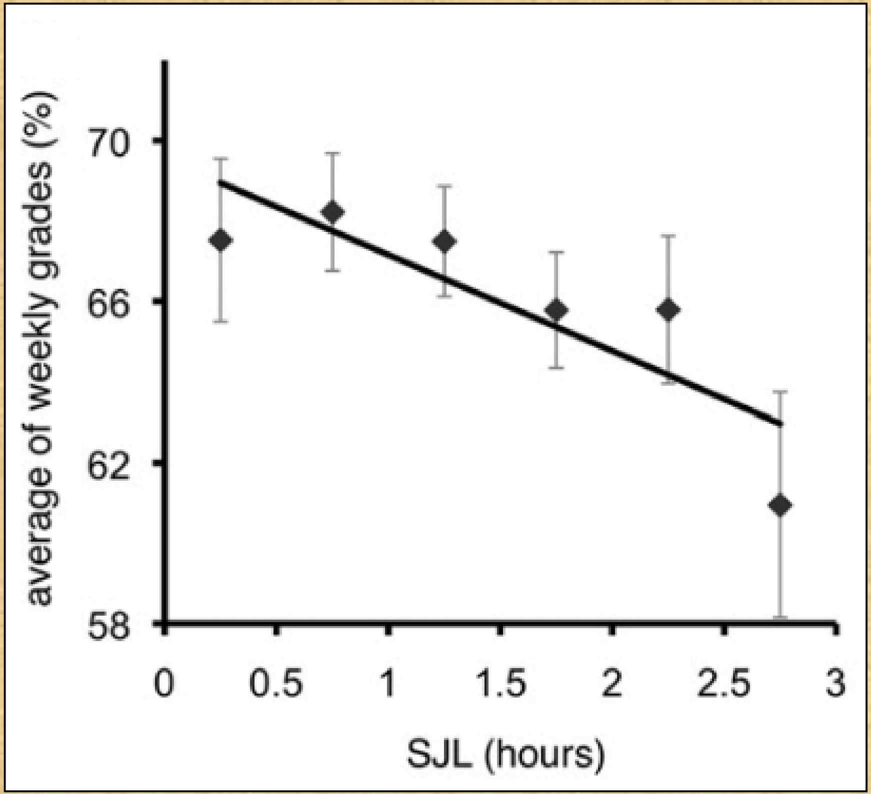
Sincerely,

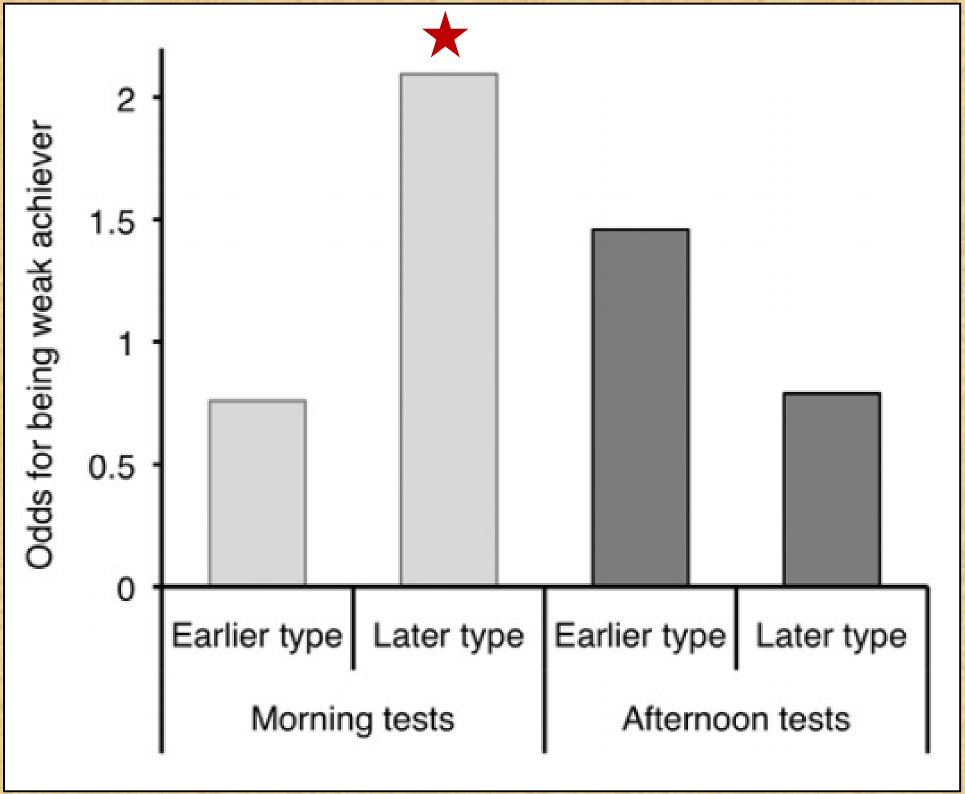
The Members of the Society for Research on Biological Rhythms

Social jetlag consequences

	Indicator		References
1	Academic performance	↓	Haraszti et al. 2014
2	Intelligence	↓	Panev et al. 2017
2	Injury rate	↑	Sondermayer 2010
3	Alcohol consumption	↑	Wittmann et al. 2006
4	Substance use	↑	Gau et al. 2007
5	Depression	↑	Levandovski et al. 2011
6	Stress	↑	Rutters et al. 2014
7	Obesity	↑	Roenneberg et al. 2012
8	Metabolic syndrome risk	↑	Parsons et al. 2015
9	Diabetes 2 type risk	↑	Reutrakul et al. 2013
10	Cardiovascular diseases risk	↑	Wong et al. 2015
11	Cancer risk	↑ ?	Borisenkov 2011
12	Aging rate	↑ ?	Ibid.

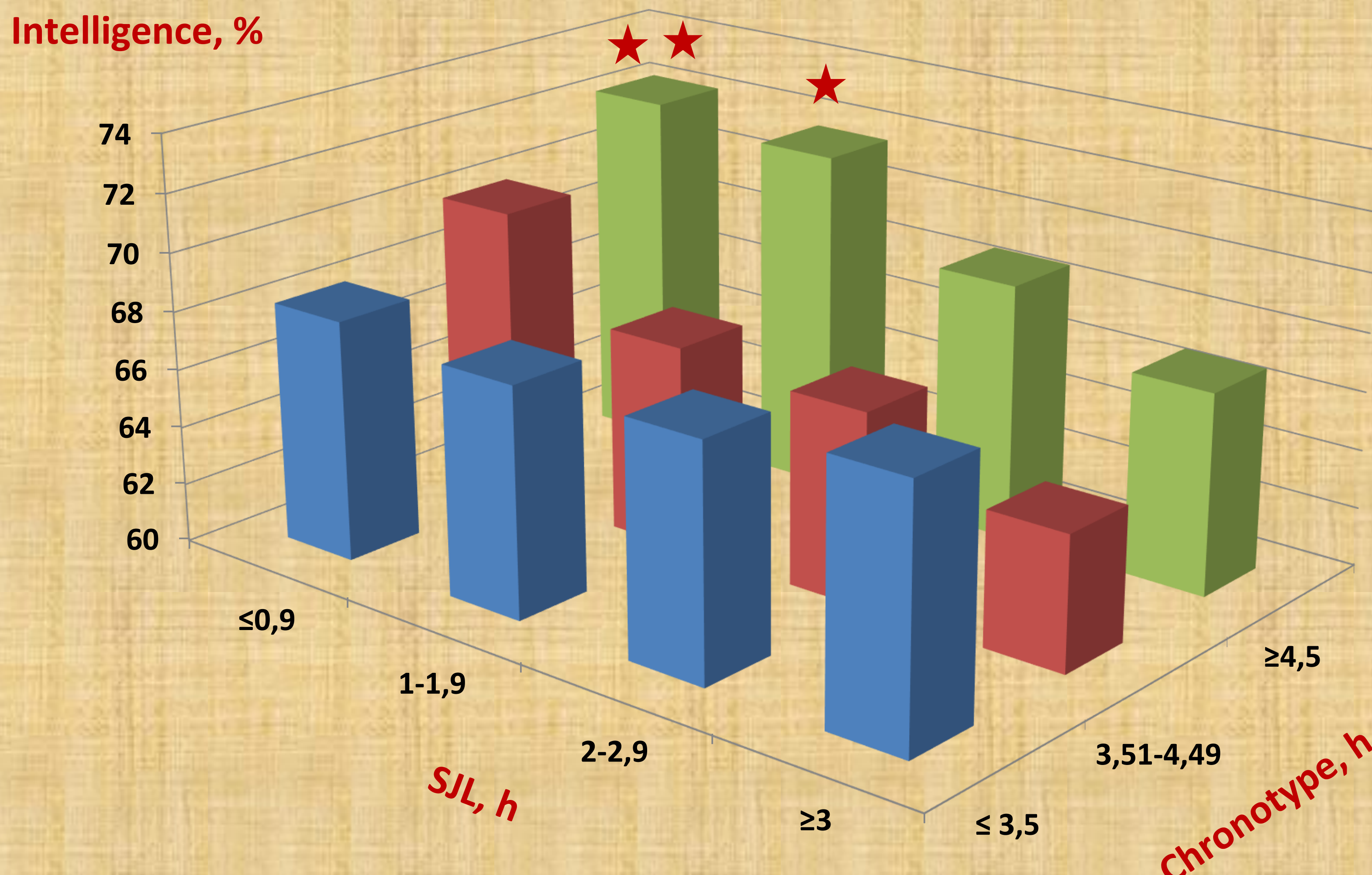
Social Jetlag and academic performance





(Haraszti et al., 2014)

Social Jetlag and non-verbal intelligence



(Panev et al., 2017)