

Chronobiology

Social jetlag is a health risk

Interview: Kolja Kröger



They are at work while most of us are asleep: shift worker at a Volkswagen factory.

Source: ddp images/dapd

Are you feeling tired? Perhaps you get up too early for your chronotype. As chronobiologist Till Roenneberg, an expert on biological clocks, points out, we all have an ideal sleep schedule. Unfortunately, the exigencies of modern life pay little heed to it.

Professor Roenneberg, you call alarm clocks “hideous contraptions.” Do you find it hard to get up in the morning?

Roenneberg: When an alarm clock rings and jerks me from the depths of sleep, I have no real idea where I am, and if the tea-caddy isn't where it should be in the kitchen, I'm totally lost. Now that the children no longer have to get up for school, I have no problem. I normally fall asleep around 1 o'clock in the morning and wake up 8 hours later. I can then work continuously for up to 16 hours. In the old alarm clock days, I was always tired during the day.

What is your secret?

Roenneberg: It's very simple. Sleep is most effective if one is free to sleep in the time window provided by the biological clock. After all, evolution 'invented' the body clock for good reasons. All our bodily functions – cellular metabolism, immune functions, even our cognitive performance – are subject to a diurnal rhythm. Up to one-third of our genes are activated in our different organs only at certain times of the day.

So when I ignore my internal clock, the system goes haywire?

Roenneberg: Exactly. We all know that lack of sleep increases our chance of catching a cold. The system is undermined and

more vulnerable to attacks of all sorts, even cancer.

Most Europeans would get up later if they didn't have to go to work.

Roenneberg: More than two-thirds of Central Europeans have become quite late chronotypes. Although this is a genetically determined trait, the modern prevalence of late chronotypes is due to the fact that we spend so much time indoors, so that we expose our body clock to light levels that are much too low. In later chronotypes, the midpoint of unconstrained sleep – subjective midnight – occurs in the early hours of the morning, so these individuals get too little sleep on workdays. The biological clock sends them to bed late and the alarm clock rouses them early. The result is a kind of chronic social jetlag, which is a huge problem, especially for shift workers.

How does the biological clock get its ideal rhythm?

Roenneberg: For most of us, the internal day is a little over 24 hours long – so the circadian clock uses daylight to synchronise to the 24-hour day. The suprachiasmatic nucleus, a tiny cluster of nerves located behind the nose and directly above the point where the optic nerves cross, senses the succession of day and

night and communicates the information to other cells.

What about genetic factors? You recently identified a gene that regulates the duration of sleep.

Roenneberg: This discovery belongs above all to my collaborator Karla Allebrandt. We collected information on sleep duration, together with genetic data, from about 4,000 individuals from Estonia to South Tyrol. Comparative analysis revealed that DNA sequence variations in the ABCC9 gene were correlated with differences in sleep duration under undisturbed conditions. Some variants are associated with differences of up to 30 minutes. So the gene must in some way be connected with sleep regulation.

How can you be so sure?

Roenneberg: The gene also exists in the fruitfly *Drosophila*, and when we inhibited it in flies, the mutants slept less during the night. So the function goes back several billion years in evolution, to the time of the last common ancestor we share with the fly lineage.

And this gene explains why you feel so helpless in the mornings!

Roenneberg: Well, it's not quite that simple. ABCC9 does not lead us directly to

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the chronotype. Our sleep requirement is actually independent of when we sleep best, i.e., when our subjective midnight occurs. There are as many short and long sleepers among those who go to bed early as among later chronotypes. The short sleepers just have fewer problems. They can retire later in the evening and still wake up before the alarm goes off.

The ABCC9 gene also seems to play a role in obesity. How is this connected with sleep duration?

Roenneberg: Chronic sleep deficit adversely affects the regulation of energy metabolism. The shorter one sleeps, the greater the risk of becoming obese. That ABCC9 has to do with energy metabolism was already known, as was the link between sleep and metabolism. ABCC9 now provides a genetic bridge between the two phenomena.

So those who sleep badly are at risk of getting fat?

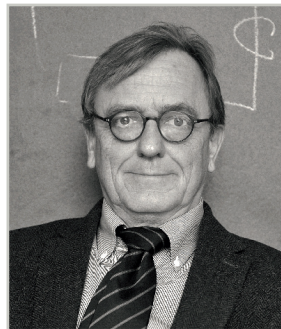
Roenneberg: Only those who already have a predisposition to chubbiness. The lean fraction of the population does not gain weight in response to social jetlag. So ABCC9 itself is not directly associated with obesity. That is not surprising, given that sleep and metabolism are each regulated by large numbers of genes.

Early birds are often seen as being more diligent.

Roenneberg: That is a misconception. On average, late chronotypes are not lazier, just as early birds are no more industrious or intelligent – even if they do better in school. The “larks” are actually more successful in high-school exams. Their cognitive abilities are up and running when school begins at eight. Among students, who generally get up later, there is no such correlation between chronotype and performance in exams.

Parents often worry that their kids stay up too late and are difficult to get out of bed in the morning. Is there anything they can do?

Roenneberg: It is perfectly normal that the biological clock in teenagers is later than in their younger siblings or their grandparents. As we mature, the midpoint of sleep is shifted to later times, and adolescents accumulate a huge sleep debt on schooldays. So one should let them sleep later on weekends, but make sure they sleep with the curtains open. Exposure to light in the morning (even when one is asleep) helps to advance the body clock. Like all other mammals, humans should make use of natural daylight to synchronise their biological clocks.



Prof. Dr. Till Roenneberg is Acting Chair of the Institute of Medical Psychology at LMU. A noted chronobiologist, he has studied biological clocks in a wide range of species, both at Harvard and currently in Munich. He reviews their workings in “Wie wir ticken” which is published by DuMont-Buchverlag. The English version, “Internal Time”, published by Harvard University Press, will appear in April.

