

Session 03 Video Press Mon 94.09.02

Why do we sleep, Russell Foster

The link

https://www.ted.com/talks/russell_foster_why_do_we_sleep?language=en

consequence

we have no consensus = we disagree

ignorance is bliss = we are happier when we have little awareness

quite profound = very deep

hypertension = high blood pressure

hypotension = low blood pressure

invade the night and occupy the dark = not sleep

sleep is for wimps = only cowards sleep

would you like me to give you more quotes?

Jump forward 400 years = go to 400 years later

Donate = give away = اهدا

Sleep-deprive sb = not let sb sleep

The wake state = when you are awake

The sleep state = when you are asleep

Neuroscientist = متخصص اعصاب و روان

Pan out = **pan out** *phrasal verb* (see also pan)

to happen or develop in a particular way:

We'll have to see how things pan out.

Enjoy the honey-heavy dew of slumber (Shakespeare)

Sleep is heritage from cave days

The text of the talk:

What I'd like to do today is talk about one of my favorite subjects, and that is the neuroscience of sleep.

00:19

Now, there is a sound --

00:22

(Alarm clock)

00:24

Ah, it worked! A sound that is desperately familiar to most of us, and of course it's the sound of the alarm clock. And what that truly ghastly, awful sound does is stop the single most important behavioral experience that we have, and that's sleep. If you're an average sort of person, 36 percent of your life will be spent asleep, which means that if you live to 90, then 32 years will have been spent entirely asleep.

01:00

Now what that 32 years is telling us is that sleep at some level is important. And yet, for most of us, we don't give sleep a second thought. We throw it away. We really just don't think about sleep. And so what I'd like to do today is

change your views, change your ideas and your thoughts about sleep. And the journey that I want to take you on, we need to start by going back in time.

01:27

"Enjoy the honey-heavy dew of slumber." Any ideas who said that? Shakespeare's Julius Caesar. Yes, let me give you a few more quotes. "O sleep, O gentle sleep, nature's soft nurse, how have I frightened thee?" Shakespeare again, from -- I won't say it -- the Scottish play.

01:50

(Laughter)

01:53

From the same time: "Sleep is the golden chain that ties health and our bodies together." Extremely prophetic, by Thomas Dekker, another Elizabethan dramatist.

02:03

But if we jump forward 400 years, the tone about sleep changes somewhat. This is from Thomas Edison, from the beginning of the 20th century: "Sleep is a criminal waste of time and a heritage from our cave days." Bang!

02:18

(Laughter)

02:20

And if we also jump into the 1980s, some of you may remember that Margaret Thatcher was reported to have said, "Sleep is for wimps." And of course the infamous -- what was his name? -- the infamous Gordon Gekko from "Wall Street" said, "Money never sleeps."

02:37

What do we do in the 20th century about sleep? Well, of course, we use Thomas Edison's light bulb to invade the night, and we occupied the dark, and in the process of this occupation, we've treated sleep as an illness, almost. We've treated it as an enemy. At most now, I suppose, we tolerate the need for sleep, and at worst perhaps many of us think of sleep as an illness that needs some sort of a cure. And our ignorance about sleep is really quite profound. Why is it? Why do we abandon sleep in our thoughts? Well, it's because you don't do anything much while you're asleep, it seems. You don't eat. You don't drink. And you don't have sex. Well, most of us anyway. And so, therefore it's -- Sorry. It's a complete waste of time, right? Wrong. Actually, sleep is an incredibly important part of our biology, and neuroscientists are beginning to explain why it's so very important. So let's move to the brain.

03:42

Now, here we have a brain. This is donated by a social scientist, and they said they didn't know what it was or indeed, how to use it, so --

03:54

(Laughter)

03:57

Sorry. So I borrowed it. I don't think they noticed. OK.

04:03

(Laughter)

04:05

The point I'm trying to make is that when you're asleep, this thing doesn't shut down. In fact, some areas of the brain are actually more active during the sleep state than during the wake state. The other thing that's really important about sleep is that it doesn't arise from a single structure within the brain, but is to some extent a network property. If we flip the brain on its back -- I love this little bit of spinal cord here -- this bit here is the hypothalamus, and right under there is a whole raft of interesting structures, not least the biological clock. The biological clock tells us when it's good to be up, when it's good to be asleep, and what that structure does is interact with a whole raft of other areas within the hypothalamus, the lateral hypothalamus, the ventrolateral preoptic nuclei. All of those combine, and they send projections down to the brain stem here. The brain stem then projects forward and bathes the cortex, this wonderfully wrinkly bit over here, with neurotransmitters that keep us awake and essentially provide us with our consciousness. So sleep arises from a whole raft of different interactions within the brain, and essentially, sleep is turned on and off as a result of a range of interactions in here.

05:17

OK. So where have we got to? We've said that sleep is complicated and it takes 32 years of our life. But what I haven't explained is what sleep is about. So why do we sleep? And it won't surprise any of you that, of course, as scientists, we don't have a consensus. There are dozens of different ideas about why we sleep, and I'm going to outline three of those.

05:42

The first is sort of the restoration idea, and it's somewhat intuitive. Essentially, all the stuff we've burned up during the day, we restore, we replace, we rebuild during the night. And indeed, as an explanation, it goes back to Aristotle, so that's what -- 2,300 years ago. It's gone in and out of fashion. It's fashionable at the moment because what's been shown is that within the brain, a whole raft of genes have been shown to be turned on only during sleep, and those genes are associated with restoration and metabolic pathways. So there's good evidence for the whole restoration hypothesis.

06:17

What about energy conservation? Again, perhaps intuitive. You essentially sleep to save calories. Now, when you do the sums, though, it doesn't really pan out. If you compare an individual who has slept at night, or stayed awake and hasn't moved very much, the energy saving of sleeping is about 110 calories a night. Now, that's the equivalent of a hot dog bun. Now, I would say that a hot dog bun is kind of a meager return for such a complicated and demanding behavior as sleep. So I'm less convinced by the energy conservation idea.

06:57

But the third idea I'm quite attracted to, which is brain processing and memory consolidation. What we know is that, if after you've tried to learn a task, and you sleep-deprive individuals, the ability to learn that task is smashed. It's really hugely attenuated. So sleep and memory consolidation is also very important. However, it's not just the laying down of memory and recalling it. What's turned out to be really exciting is that our ability to come up with novel

solutions to complex problems is hugely enhanced by a night of sleep. In fact, it's been estimated to give us a threefold advantage. Sleeping at night enhances our creativity. And what seems to be going on is that, in the brain, those neural connections that are important, those synaptic connections that are important, are linked and strengthened, while those that are less important tend to fade away and be less important.

07:51

OK. So we've had three explanations for why we might sleep, and I think the important thing to realize is that the details will vary, and it's probable we sleep for multiple different reasons. But sleep is not an indulgence. It's not some sort of thing that we can take on board rather casually. I think that sleep was once likened to an upgrade from economy to business class, you know, the equivalent of. It's not even an upgrade from economy to first class. The critical thing to realize is that if you don't sleep, you don't fly. Essentially, you never get there. And what's extraordinary about much of our society these days is that we are desperately sleep-deprived.

08:35

So let's now look at sleep deprivation. Huge sectors of society are sleep-deprived, and let's look at our sleep-o-meter. So in the 1950s, good data suggests that most of us were getting around eight hours of sleep a night. Nowadays, we sleep one and a half to two hours less every night, so we're in the six-and-a-half-hours every-night league. For teenagers, it's worse, much worse. They need nine hours for full brain performance, and many of them, on a school night, are only getting five hours of sleep. It's simply not enough. If we think about other sectors of society -- the aged; if you are aged, then your ability to sleep in a single block is somewhat disrupted, and many sleep, again, less than five hours a night.

09:21

Shift work. Shift work is extraordinary, perhaps 20 percent of the working population, and the body clock does not shift to the demands of working at night. It's locked onto the same light-dark cycle as the rest of us. So when the poor old shift worker is going home to try and sleep during the day, desperately tired, the body clock is saying, "Wake up. This is the time to be awake." So the quality of sleep that you get as a night shift worker is usually very poor, again in that sort of five-hour region. And then, of course, tens of millions of people suffer from jet lag. So who here has jet lag? Well, my goodness gracious. Well, thank you very much indeed for not falling asleep, because that's what your brain is craving.

10:02

One of the things that the brain does is indulge in micro-sleeps, this involuntary falling asleep, and you have essentially no control over it. Now, micro-sleeps can be sort of somewhat embarrassing, but they can also be deadly. It's been estimated that 31 percent of drivers will fall asleep at the wheel at least once in their life, and in the US, the statistics are pretty good: 100,000 accidents on the freeway have been associated with tiredness, loss of vigilance, and falling asleep -- a hundred thousand a year. It's extraordinary. At another level of terror, we dip into the tragic accidents at Chernobyl and

indeed the space shuttle Challenger, which was so tragically lost. And in the investigations that followed those disasters, poor judgment as a result of extended shift work and loss of vigilance and tiredness was attributed to a big chunk of those disasters. When you're tired and you lack sleep, you have poor memory, you have poor creativity, you have increased impulsiveness, and you have overall poor judgment. But my friends, it's so much worse than that.

11:15

(Laughter)

11:17

If you are a tired brain, the brain is craving things to wake it up. So drugs, stimulants. Caffeine represents the stimulant of choice across much of the Western world. Much of the day is fueled by caffeine, and if you're a really naughty tired brain, nicotine. Of course, you're fueling the waking state with these stimulants, and then, of course, it gets to 11 o'clock at night, and the brain says to itself, "Actually, I need to be asleep fairly shortly. What do we do about that when I'm feeling completely wired?" Well, of course, you then resort to alcohol. Now alcohol, short-term, you know, once or twice, to use to mildly sedate you, can be very useful. It can actually ease the sleep transition. But what you must be so aware of is that alcohol doesn't provide sleep. A biological mimic for sleep, it sedates you. So it actually harms some of the neural processing that's going on during memory consolidation and memory recall. So it's a short-term acute measure, but for goodness sake, don't become addicted to alcohol as a way of getting to sleep every night.

12:21

Another connection between loss of sleep is weight gain. If you sleep around about five hours or less every night, then you have a 50 percent likelihood of being obese. What's the connection here? Well, sleep loss seems to give rise to the release of the hormone ghrelin, the hunger hormone. Ghrelin is released. It gets to the brain. The brain says, "I need carbohydrates," and what it does is seek out carbohydrates and particularly sugars. So there's a link between tiredness and the metabolic predisposition for weight gain: stress. Tired people are massively stressed. And one of the things of stress, of course, is loss of memory, which is what I sort of just then had a little lapse of. But stress is so much more. So, if you're acutely stressed, not a great problem, but it's sustained stress associated with sleep loss that's the problem. Sustained stress leads to suppressed immunity. And so, tired people tend to have higher rates of overall infection, and there's some very good studies showing that shift workers, for example, have higher rates of cancer. Increased levels of stress throw glucose into the circulation. Glucose becomes a dominant part of the vasculature and essentially you become glucose intolerant. Therefore, diabetes 2. Stress increases cardiovascular disease as a result of raising blood pressure. So there's a whole raft of things associated with sleep loss that are more than just a mildly impaired brain, which is where I think most people think that sleep loss resides.

13:56

So at this point in the talk, this is a nice time to think, "Well, do you think on the whole I'm getting enough sleep?" So a quick show of hands. Who feels that

they're getting enough sleep here? Oh. Well, that's pretty impressive. Good. We'll talk more about that later, about what are your tips.

14:13

So most of us, of course, ask the question, "How do I know whether I'm getting enough sleep?" Well, it's not rocket science. If you need an alarm clock to get you out of bed in the morning, if you are taking a long time to get up, if you need lots of stimulants, if you're grumpy, if you're irritable, if you're told by your work colleagues that you're looking tired and irritable, chances are you are sleep-deprived. Listen to them. Listen to yourself.

14:36

What do you do? Well -- and this is slightly offensive -- sleep for dummies.

14:41

(Laughter)

14:43

Make your bedroom a haven for sleep. The first critical thing is make it as dark as you possibly can, and also make it slightly cool. Very important. Actually, reduce your amount of light exposure at least half an hour before you go to bed. Light increases levels of alertness and will delay sleep. What's the last thing that most of us do before we go to bed? We stand in a massively lit bathroom, looking into the mirror cleaning our teeth. It's the worst thing we can possibly do before we go to sleep. Turn off those mobile phones. Turn off those computers. Turn off all of those things that are also going to excite the brain. Try not to drink caffeine too late in the day, ideally not after lunch.

15:24

Now, we've set about reducing light exposure before you go to bed, but light exposure in the morning is very good at setting the biological clock to the light-dark cycle. So seek out morning light. Basically, listen to yourself. Wind down. Do those sorts of things that you know are going to ease you off into the honey-heavy dew of slumber.

15:45

OK. That's some facts. What about some myths?

15:48

Teenagers are lazy. No. Poor things. They have a biological predisposition to go to bed late and get up late, so give them a break.

15:56

We need eight hours of sleep a night. That's an average. Some people need more. Some people need less. And what you need to do is listen to your body. Do you need that much or do you need more? Simple as that.

16:09

Old people need less sleep. Not true. The sleep demands of the aged do not go down. Essentially, sleep fragments and becomes less robust, but sleep requirements do not go down.

16:22

And the fourth myth is early to bed, early to rise makes a man healthy, wealthy and wise. Well, that's wrong at so many different levels.

16:32

(Laughter)

16:34

There is no evidence that getting up early and going to bed early gives you more wealth at all. There's no difference in socioeconomic status. In my experience, the only difference between morning people and evening people is that those people that get up in the morning early are just horribly smug.

16:50

(Laughter)

16:52

(Applause)

16:55

OK. So for the last few minutes, what I want to do is change gears and talk about some really new, breaking areas of neuroscience, which is the association between mental health, mental illness and sleep disruption. We've known for 130 years that in severe mental illness, there is always, always sleep disruption, but it's been largely ignored. In the 1970s, when people started to think about this again, they said, "Yes, well, of course you have sleep disruption in schizophrenia, because they're on antipsychotics. It's the antipsychotics causing the sleep problems," ignoring the fact that for a hundred years previously, sleep disruption had been reported before antipsychotics.

17:36

So what's going on? Several groups are studying conditions like depression, schizophrenia and bipolar and what's going on in terms of sleep disruption. We have a big study which we published last year on schizophrenia, and the data were quite extraordinary. In those individuals with schizophrenia, much of the time, they were awake during the night phase and then they were asleep during the day. Other groups showed no 24-hour patterns whatsoever -- their sleep was absolutely smashed. And some had no ability to regulate their sleep by the light-dark cycle. They were getting up later and later and later and later each night. It was smashed.

18:17

So what's going on? And the really exciting news is that mental illness and sleep are not simply associated, but they are physically linked within the brain. The neural networks that predispose you to normal sleep, give you normal sleep, and those that give you normal mental health, are overlapping. And what's the evidence for that? Well, genes that have been shown to be very important in the generation of normal sleep, when mutated, when changed, also predispose individuals to mental health problems. And last year, we published a study which showed that a gene that's been linked to schizophrenia, when mutated, also smashes the sleep. So we have evidence of a genuine mechanistic overlap between these two important systems.

19:04

Other work flowed from these studies. The first was that sleep disruption actually precedes certain types of mental illness, and we've shown that in those young individuals who are at high risk of developing bipolar disorder, they already have a sleep abnormality prior to any clinical diagnosis of bipolar. The other bit of data was that sleep disruption may actually exacerbate, make

worse, the mental illness state. My colleague Dan Freeman has used a range of agents which have stabilized sleep and reduced levels of paranoia in those individuals by 50 percent.

19:45

So what have we got? We've got, in these connections, some really exciting things. In terms of the neuroscience, by understanding these two systems, we're really beginning to understand how both sleep and mental illness are generated and regulated within the brain. The second area is that if we can use sleep and sleep disruption as an early warning signal, then we have the chance of going in. If we know these individuals are vulnerable, early intervention then becomes possible. And the third, which I think is the most exciting, is that we can think of the sleep centers within the brain as a new therapeutic target. Stabilize sleep in those individuals who are vulnerable, we can certainly make them healthier, but also alleviate some of the appalling symptoms of mental illness.

20:32

So let me just finish. What I started by saying is: Take sleep seriously. Our attitudes toward sleep are so very different from a pre-industrial age, when we were almost wrapped in a duvet. We used to understand intuitively the importance of sleep. And this isn't some sort of crystal-waving nonsense. This is a pragmatic response to good health. If you have good sleep, it increases your concentration, attention, decision-making, creativity, social skills, health. If you get sleep, it reduces your mood changes, your stress, your levels of anger, your impulsivity, and your tendency to drink and take drugs. And we finished by saying that an understanding of the neuroscience of sleep is really informing the way we think about some of the causes of mental illness, and indeed is providing us new ways to treat these incredibly debilitating conditions.

21:26

Jim Butcher, the fantasy writer, said, "Sleep is God. Go worship." And I can only recommend that you do the same.

21:34

Thank you for your attention.

21:36

(Applause)

Good luck

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